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# Electrical World

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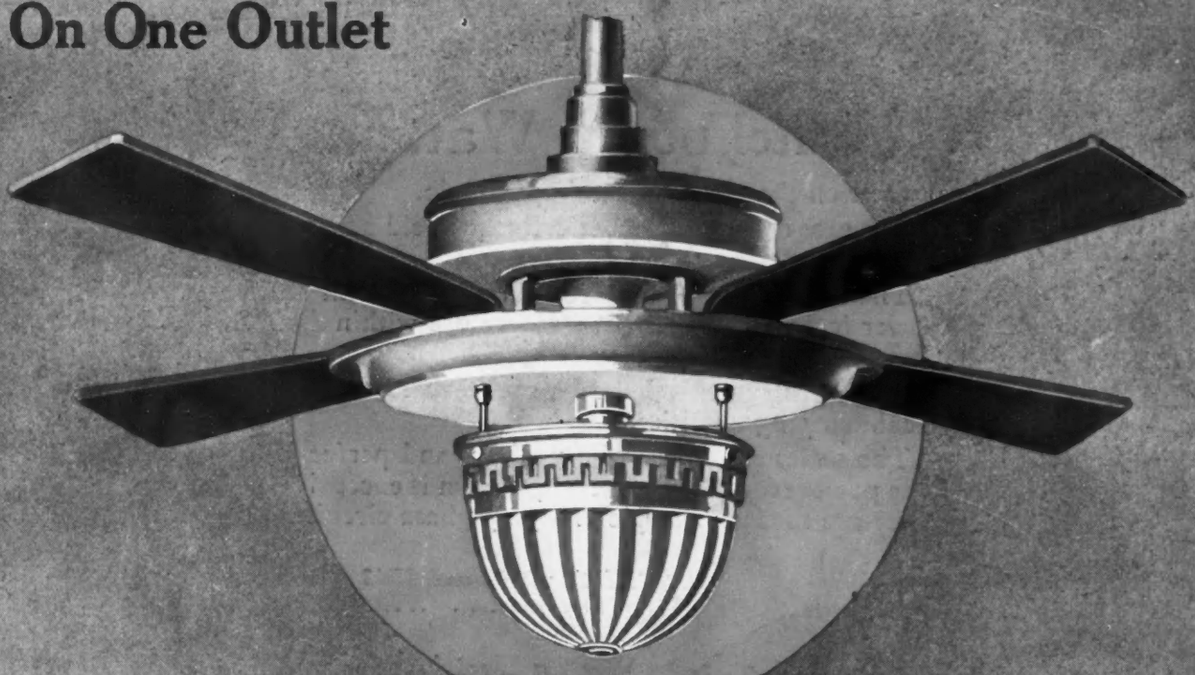

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# Electrical World

New York, Saturday, June 25, 1921

## *The Utilization of Our Many Convention Papers*

ONE of America's greatest men attributed his success in large measure to a habit which he established early in his working life and pursued persistently throughout his long career. He set himself each year to learn one new thing thoroughly. It might be a different line of business which he investigated and studied. It might be a new subject to read and carefully digest. It might be simply another sport or hobby to practice and master. But each year saw this fresh objective. It brought a broadened interest and a bigger life.

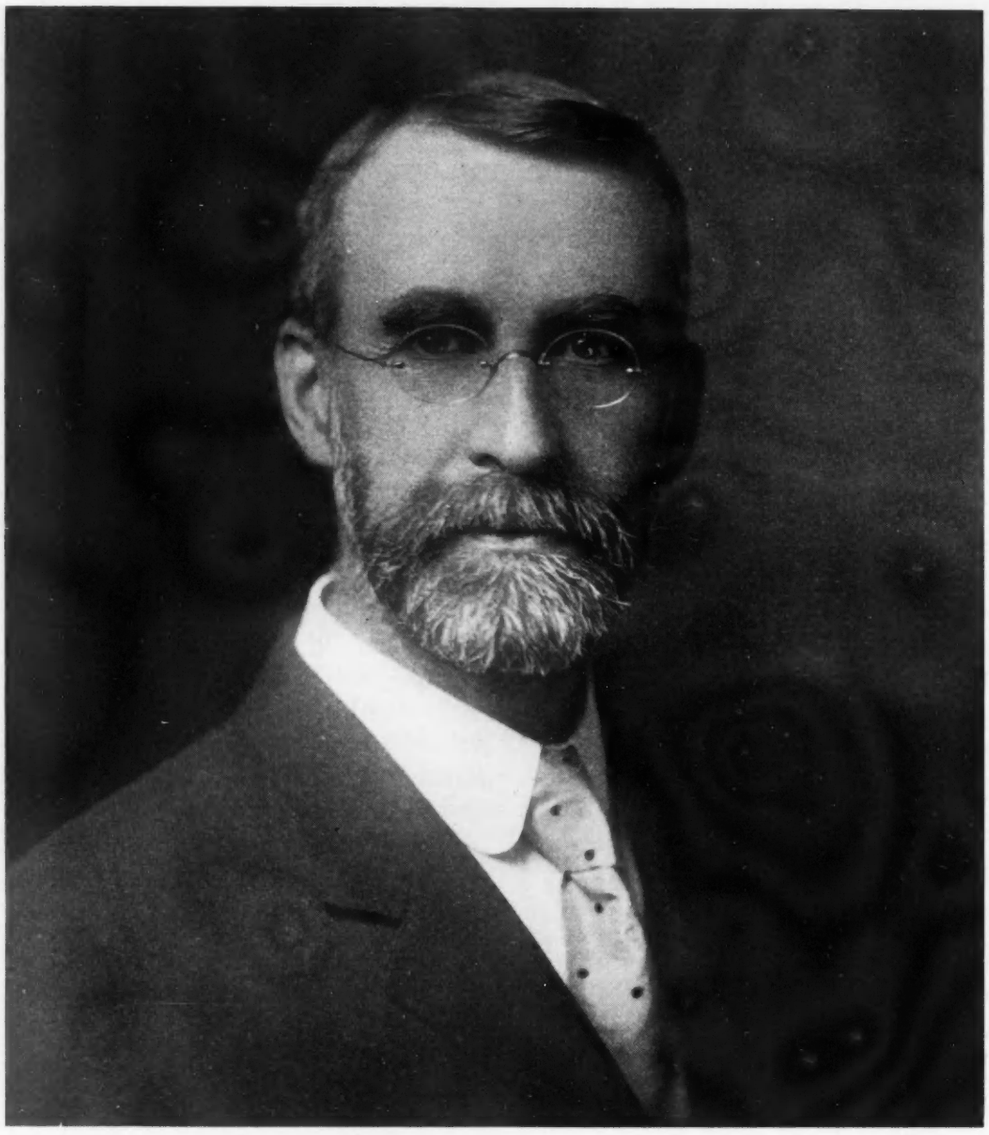
There is a practical suggestion here for electrical men right at this time, for the National Electric Light Association has just presented to us something of great value which we are about to throw away. Men of the industry have just gathered and compiled a huge mass of priceless information and advice. The N. E. L. A. has published it and bestowed it upon us. But its value lies not in possession, but in utilization. It has enormous usefulness, tremendous power for production and for progress. Yet in the past the most of it has ever been in large part lost because there was so much of it. Men fail to read these papers with an eager and retentive mind and to apply constructively the parts they would like so to apply. The inclination is to pile these publications on a shelf, and then, with good intentions, leave them there neglected.

But each man among us could *at least* learn one thing thoroughly out of this treasure and apply it. If he would consider it an obligation to his industry that this great store of mental meat and bread be not entirely wasted *on him*—if he would but feel it the literal truth that this exhaustive work has all been done that *he*, and others, may gain a profit from it—could any man accept this gift and do less?

This is a point o' view toward the convention papers that electrical men should think about. For there is an economic loss involved in their neglect as well as a personal loss. There is an element of moral obligation that the individual should recognize. There is a proffered opportunity that cannot be ignored without offense. The gift is made in trust.

If you would do your part as an electrical man this year, read your own subject thoroughly in your convention papers. Study it. Apply it. Make good the work that has been done for you by a practical and profitable utilization.

Then read and learn at least one new thing also—one different subject. Broaden your interest and your knowledge in your industry. Follow this new subject week by week in the ELECTRICAL WORLD. Learn one new thing this year.



## Charles Thomas Main

*A consultant of national reputation in the industrial and power plant fields who has a fine conception of the broader rôle the engineer can play in public affairs*

LARGE affairs are calling out the professional skill and public spirit of American engineers as never before in times of peace. The advice, the constructive insight and the untiring energy of such men are big factors in the nation's advance, factors not less potent because of their quiet application. A man of this type, eminent in the eyes of his confrères, is Charles T. Main, industrial engineer, of Boston. Born of colonial ancestry at Marblehead, Mass., in 1856, Mr. Main was graduated at the age of twenty from the Massachusetts Institute of Technology in the department of mechanical engineering. After three years as an assistant on the instructing staff, he entered the textile engineering field at Manchester, N. H., soon going to the Lower Pacific Mills at Lawrence, Mass., where in 1887 he was made superintendent. During a period of eleven years, which included the reorganization and rebuilding of the Pacific Mills plant, Mr. Main directed the work, never letting go his hold upon engineering in the press of administrative duties. Finally he entered the consulting field, forming a partnership in 1893 with F. W. Dean, under the firm name of Dean & Main, at Boston. This association continued until 1907, when Mr. Main established an independent office under his own name.

Many large industrial, steam and hydro-electric plants bear the impress of Mr. Main's engineering talents. Among these are the Wood Worsted and Ayer Mills in Lawrence, and in the water-power field four large developments for the Montana Power Company. Mr. Main has served as consulting engineer on many projects and as expert witness or referee in important legal actions.

Mr. Main is a past-president of the American Society of Mechanical Engineers and of the Boston Society of Civil Engineers. He is president of the Engineers' Club of Boston and a life member of the corporation of the Massachusetts Institute of Technology. Mr. Main's name is familiar to many readers of the technical press, and his contributions to professional gatherings have been numerous and useful. As a member of a special commission organized a few years ago to further water-power conservation in Massachusetts he performed distinguished service. In December, 1918, Mr. Main went to France as a member of a commission to confer with the French Society of Engineers upon reconstruction in the war zone. He sailed again on June 1 last to represent the American Society of Mechanical Engineers at the second World Cotton Conference, to be held in Liverpool, England, and he is also chairman of a delegation to represent the American Society of Civil Engineers at the engineering conference to be held in London, June 29 to July 1, and to participate in the presentation of the John Fritz medal to Sir Robert Hadfield.

# Electrical World

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*Volume* 77 New York, Saturday, June 25, 1921 *Number* 26

## Committees on Public Information Should Be Supported

A GREAT service for public utilities of all classes is being rendered by the committees on public information now active in many states. Granting that the public is just if it is in possession of all the facts, the need of some central bureau for disseminating public utility information is apparent. The committee in Illinois, being longest in existence and therefore oldest in experience, has served as an example and inspiration to many others, and its work is indicative of what may be done in any other state where the committee is properly supported. The work is truly co-operative, and if it is to be at all effective, it must be supported by the electric light, railway, telephone, water, gas and other utility interests. The cost to the individual utility is nominal, and the benefit, though indirect, is none the less certain. In some states, notably Missouri, where enthusiasm was at first high interest is now beginning to wane through lack of funds. This is all wrong. The plan is certainly worthy of support, and those having the work in hand should not be handicapped. For the modest sum of from $15,000 to $25,000 a year it is possible to maintain a fairly respectable public information bureau, and when this cost is prorated among all the utilities of a state no single utility will find it burdensome. Possibly if the cost were higher the work would be appreciated more. Nevertheless, its cheapness is what commends it, and the work should not be considered any less desirable because it does not involve a great expenditure.

## Fundamental Costs of Rural Service Must Be Studied

RURAL-SERVICE rate problems cannot be solved until the basic problems of financing, construction and operating have been solved. The present confusion in the rural-service situation is due almost entirely to a failure on the part of central-station executives to size up the fundamentals of the problem. In many cases the course of action has resembled a running jump to arrive at rates, with no attempt to find what these rates are being made to cover.

Fundamentally the problem is one of service. A certain amount of equipment must be employed and maintained. The conditions are such that previous experience is likely to be misleading. Investments and operating costs are radically greater than for any other class of service. Moreover, there will also be a variation between every two rural-service installations. The companies that are thinking most clearly are confining their rate-making efforts to the construction of a schedule under which each extension will receive individual treatment. As a general rule the energy charge is based on the schedules in use for the same class of service. In addition, the fixed and operating charges for each extension are carefully worked out and a fixed charge for service is applied. The charge will not be uniform over any system, and consequently the average cost per kilowatt-hour will vary as between extensions and also as between consumers on the same line in proportion to the energy used.

## Mutual Confidence and Seeing the Other's Viewpoint

THE most hopeful sign yet apparent in the effort being made to solve the problem of inductive interference is the recognition by both power-distributing and communication companies that they must get together for the purpose of understanding each other's viewpoint and for discussing plans that may affect the service of either. Contests before the courts and regulatory bodies are due in no small part to a lack of understanding of each other's problems and a lack of consideration of each other's rights.

Perhaps the most disturbing element in the present situation is the establishment of so-called precedents through court or commission decisions. These precedents must be carefully studied; such precedents as are based on sound economic principles must stand; those based on partial facts presented before a judicial body must be discarded. In its final analysis, however, the problem is not one for legal treatment, nor is it one to which legalistic methods can rightfully be applied. The question at issue is the right of the public to have two essential services at a cost that will not prohibit rapid extension of either and at the greatest possible efficiency. Obviously a general solution cannot be reached by judicial consideration of the few facts that are present in any single case. Nor can any court or commission be expected to go into the technical and economic aspects of the matter and establish rules that will cover all phases of the problem. Without a thorough understanding of the technical problems no one can hope to determine the economic problems. It therefore follows that the men of the two industries involved must provide the ultimate solution.

At the present time there are all too many cases that have been carried before commissions or courts. It is not necessary to apportion the blame for such a situation. The quickest way of relief is to hasten the effective organization of state joint committees, take up pending cases, arrive at a settlement and ask for the dismissal of contests without letting them go to a formal decision.

The plan which was outlined before the N. E. L. A. at Chicago recently by the public policy sub-committee on inductive interference is workable. The organization proposed can function and eliminate any excuse for taking controversies to commissions or courts. The two industries need only to avail themselves of it. In the words of the doughboy, "Let's go!"

### A Right Use of Authority by a Public Service Commission

HOW wise direction by a public service commission may work to the public benefit, even to the extent of affecting prices, was shown by the recent action of the California Railroad Commission in ordering an interconnection between the systems of two large central-station companies. In this instance the Great Western Power Company and the Pacific Gas & Electric Company were both asking the commission to continue a 15 per cent surcharge. The commission responded by bringing about an arrangement whereby one company, needing power, purchased of the other company, which needed a larger market. It was further stipulated that the most efficient steam plants of both companies should be operated on joint account. The commission held that the new arrangement would have a material bearing on the need for continuing the surcharge, which, in fact, it subsequently reduced more than half. This particular form of commission activity, which virtually directs companies to co-operate to the benefit of all concerned, is a step in the right direction. If all commissions will use wisely and fairly the best means at hand to help both companies and public to a more efficient supply of electric power, they will justify the laws that have intrusted to them such heavy responsibilities.

### Problems of Transmission at 220,000 Volts Are Being Solved

OPINION among operating engineers appears to be crystallizing in favor of a national standard of 220,000 volts for extra-long bulk-supply transmission lines. For this service the value advocated is an excellent one because, as is made clear by F. G. Baum elsewhere in this number of the ELECTRICAL WORLD, it enables the economical transmission of large amounts of power over distances as great as 1,000 miles and, besides, is a simple multiple of voltages now firmly established. However, engineers should not confuse long lines in which power is transmitted the entire length with long lines having intermediate feed-in and feed-out taps, since the latter serve chiefly for interchange of power and seldom if ever have to transmit energy the entire length.

For the 220,000-volt insulator string three alternatives have been discussed—(1) the use of larger and heavier insulator units, (2) grading, or the use of units of high electrostatic capacity at the line end of the string to ease the electric stress on these units, and (3) the application of metal shields in such a way as to lower the voltage gradient at the units next the line. The second and third methods, and especially the last, appear to offer the best solution according to the classic studies carried out in the Stanford University laboratories by Professor Ryan, Mr. Baum and others. A combination of grading and shielding is also being considered. These tests have shown that even after the units next the line have been relieved there is great danger that flashovers will strike in at the upper units, themselves under low unit stresses, unless this contingency is carefully guarded against. Mr. Baum summarizes the whole situation by saying that the line insulators must be made as reliable as the transformers and other apparatus before the insulation problem can be considered fully solved.

The voltage control of long lines cannot be accomplished satisfactorily at the generator alone. The heavy and ever-changing charging current along the line, not to mention changing loads at various points in the line, call for remedies which Mr. Baum happily compares to the loading of telephone lines. Synchronous condensers distributed along the line give the obvious and apparently complete solution of this problem.

### Are Gas-Filled Lamps Going to Supplant the Vacuum Type?

WHEN the metallic-filament lamp first appeared the very slender filaments of lamps rated below 40 or 50 watts possessed an undeniable fragility that operated against the popularity of these smaller sizes. However, the drawn-wire filament changed this situation very radically, and now there is no apparent reason why 15-watt and even smaller lamps cannot be freely used in suitable situations. At present the vital question is, how low can the candlepower of the gas-filled lamp be carried to advantage? Comparative figures for the 100-watt size indicate that so far as cost is concerned there is no excuse for the 100-watt vacuum lamp. None the less, this size is one which is used almost entirely for commercial and industrial lighting and the situation regarding the smaller sizes is still somewhat uncertain. Quite probably the gas-filled lamp could be furnished in all the usual sizes with a slight gain in efficiency, but its temperature and intense brilliancy co-operate to produce a lamp not altogether desirable for domestic service. In such service particular care must be taken on account of the heat, and the necessary shading may overbalance the increase in lumens per watt.

Inasmuch as the United States is about the only country in which 220-volt metallic-filament lamps are not used extensively, it would seem worth while to start a searching inquiry as to the real merits of the 220-volt lamp on the basis of actual practice in the countries where it is standardized.

### Field of Motor Application Rapidly Extending in the South

WITHIN less than ten years the use of electric power in the growing industries of the South has increased to a very large extent. Today the connected load is fully two and a half times as great as at the beginning of the world war. Considered on the basis of actual energy consumption the load has increased more than fourfold. A summary of the facts which the ELECTRICAL WORLD has collected from this section of the country is given elsewhere in the current issue. Briefly, more than a thousand plants use electricity as their chief source of power. The energy generated locally is somewhat less than that purchased, in the ratio of about two to three. Perhaps this relatively small difference is partly due to the fact that a much greater proportion of the industries generating their own power than of those purchasing power replied to our questionnaire.

The great industries from the standpoint of electric service are the textile, the lumber, the chemical. The first named was the pioneer in electric drive on a considerable scale, and the total amount of energy taken by the Southern mills now certainly runs above 800,000,000 kw.-hr. There are more than 60,000 motors in these mills, more than three-quarters of them being under 5 hp. In the lumber industry the power consumption

is conspicuously less, below 200,000,000 kw.-hr., of which more than half is generated by private plants, as might be expected from the isolation of the industry and the waste available for fuel. Although only 7,000 motors are in service, their average rating is considerably larger than that of the textile motors, about 10 hp.

Looking at the rapid growth of the past few years and the possibilities springing up all over the great Southern territory, it is clear that there is a vast field yet untouched in the application of motors to manufacturing, a field certain to be opened up as the resources of the South begin to be better understood. Amplification of the existing electric service facilities will assist greatly in this development.

## Need of Accurate Records on Cable Temperatures

THE ever-increasing desire for economical operation has brought those interested in underground lines face to face with several questions which demand an answer. Not only will it be necessary to know the maximum allowable temperature of all makes of cables in order to predetermine failures due to overloads, but it will also be necessary to know the effect on the length of life of the cable due to various temperatures and also the effect due to temperature changes. Briefly, all the effects of temperature on underground cables must be analyzed. It would seem at first that, considering the large investment represented by the duct line and the cables it carries, economy would dictate carrying currents as large as can be carried without failure of any one cable. However, it can be seen that, if the life of the cables is considerably reduced by high temperatures, it may prove too expensive to replace the cable at frequent intervals. The report of the underground systems committee of the National Electric Light Association brings out forcibly the importance of determining all such points.

Experience has indicated the need of means of determining accurately and easily the temperature of cables at all points of the duct lines. Considering the large amount of data compiled in the last few years regarding failures of cables, it is quite evident that if there were accurate records of the actual temperatures to which these cables were subjected very interesting conclusions could be drawn. With only a relatively small amount of further investigation the maximum allowable temperature of cables and the effect of high temperatures and variations in temperature on the life of the cable could be evaluated with such accuracy that the economies of operation attainable with underground cables could be definitely known.

## Automatic Station Should Facilitate Small Power Development

FROM time to time we have described some of the automatic stations which have gradually been coming into use. Among others we gave some account of the 1,500-kva. plant at Cedar Rapids. After three and a half years of use there have been none but good reports from this equipment. The sum and substance of the story is that the expense of operation has been almost negligible. The plant generates about 7,500,000 kw.-hr. per year, and the average maintenance and operating charge thus far has been only $178 annually. The inspection given to the station consists in a daily cleaning of the racks by one of the boiler-room employees, which takes about thirty minutes, and an electrical and mechanical inspection weekly, requiring about two hours. Aside from the very low cost of operation, the abolition of labor is a particularly good thing on account of the difficulty in keeping operators at any price on an isolated and lonesome job like tending a small hydro-electric plant. The yearly fixed charges against the plant are $33,600, beside which the actual operating and maintenance cost is a very insignificant figure. The cost for delivered power on this basis is 0.45 cent per kilowatt-hour.

Several of these automatic plants are now in successful operation, some having gone into service during the current year. Others are on order, one of them to have 750 kva. in a single unit, and will presently be at work to keep down the cost of energy. In all the cases mentioned the generator is of the synchronous type, while the voltage varies all the way from 6,000 to 11,500 in the various instances. There is no doubt whatever that the automatic station has come to stay and will produce a very beneficial effect in certain situations. In particular it is likely to be of great importance in linking up small hydraulic powers situated on the same or near-by streams and which it would be quite impracticable to use if attendance should be required all or during any substantial part of the time at every station.

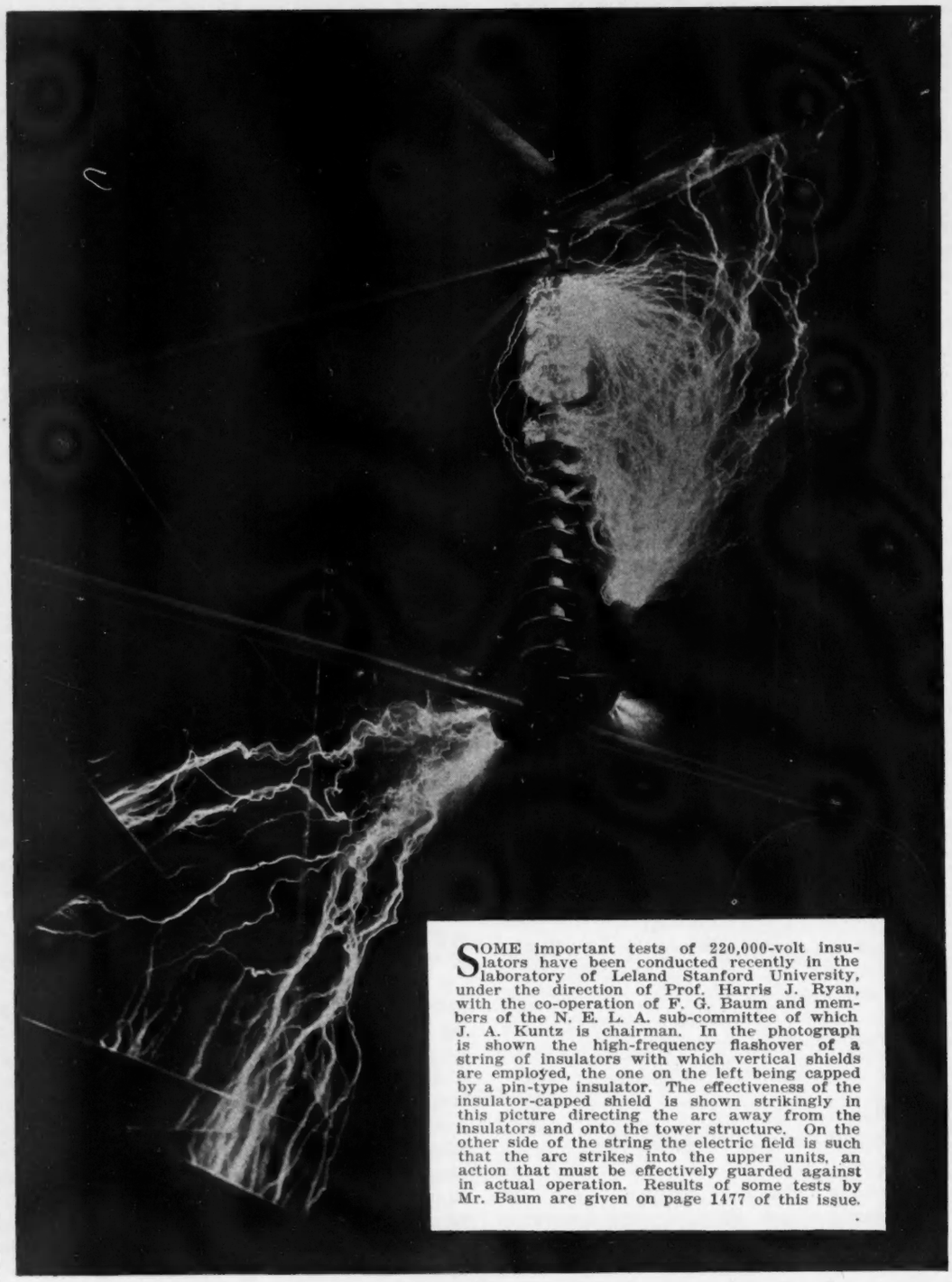
## Spectacular Methods Not Necessary for Economical Plant Operation

A POOR workman supplied with the finest tools will still produce poor work, but when to a decent tool equipment is added the skill of interested and contented men who are competent to use the tools the best results may be expected. An example that should carry a forceful lesson to steam-plant operators is given in C. H. McClintock's discussion of the Denver Tramway Company's plant practice in this issue.

The foundation on which to build was not the best, the load curve, fuel and water conditions leaving something to be desired and the fuel conditions being such as to dismay those accustomed to the high-grade Eastern coal. By intelligent redesign of an old plant and intelligent and persistent training and supervision of the operating force, however, a kilowatt-hour is being produced on a basis of 23,750 B.t.u. Only a few of the larger steam stations are bettering this figure, and such a record for a plant carrying momentary peaks of 10,000 kw. and handling only street-railway load is a rather remarkable accomplishment. There is nothing spectacular in the equipment or methods and nothing that cannot be equally well accomplished in any plant of its size—or even in smaller plants if a fair degree of careful study and persistent reaching for results is employed.

The real difficulty at the root of much of the inefficiency of the small steam plants is the tendency to employ guesswork methods rather than devote energy to a careful analysis of conditions on which an intelligent elimination of wastes can be undertaken. Improper selection of equipment and wastes due to careless or unintelligent operation are the big factors in poor steam-plant results. There are many other companies that can accomplish what the Denver Tramway Company has already done, and a careful study of Mr. McClintock's article will benefit every operator of a small electric-generating plant.

# Flashovers Can Be Directed Away from Insulator Disks



SOME important tests of 220,000-volt insulators have been conducted recently in the laboratory of Leland Stanford University, under the direction of Prof. Harris J. Ryan, with the co-operation of F. G. Baum and members of the N. E. L. A. sub-committee of which J. A. Kuntz is chairman. In the photograph is shown the high-frequency flashover of a string of insulators with which vertical shields are employed, the one on the left being capped by a pin-type insulator. The effectiveness of the insulator-capped shield is shown strikingly in this picture directing the arc away from the insulators and onto the tower structure. On the other side of the string the electric field is such that the arc strikes into the upper units, an action that must be effectively guarded against in actual operation. Results of some tests by Mr. Baum are given on page 1477 of this issue.

# A. I. E. E. Convention
## at Salt Lake City

**Thirty-seventh Annual and Tenth Pacific Coast Convention Drew Large Audience from the East and Far West—Thirteen Technical Committees Submit Reports —Water-Power and Long-Distance Bulk-Power Transmission Were the Subjects of the Principal Papers—President Berresford Points Way for Proper Industrial Development**

PERMITTING as it did the combination of business and a vacation trip through the scenic West, the Salt Lake City convention of the American Institute of Electrical Engineers drew an unusually large attendance this week from the East. The convention proper lasted from Tuesday morning to Friday noon, but entertainment, recreation and trips to various points of interest held many delegates the entire week. On the opening day Charles R. Mabey, Governor of Utah, delivered an address of welcome and Arthur W. Berresford made the annual presidential address. Following this thirteen technical committee reports and two papers on hydraulic subjects were presented. Abstracts of these, the president's address and a paper by F. G. Baum on voltage regulation of long lines are published in this issue, the latter beginning on page 1477. Next week there will be published abstracts and discussions of the remaining papers, which deal with long-distance bulk-power transmission lines and interconnections, insulator production and problems, harmonics and air strength, and miscellaneous subjects.

### *President's Address*

For the proper development and economical operation of any industry, said Arthur W. Berresford, in his presidential address, the major interests in that industry must have the understanding, support and good will of those less important. This is true because the policies of a minor manufacturer may be directly contrary to the interests of the industry as a whole, not by intent, but by reason of a limited viewpoint. Such a manufacturer would be entirely willing to reverse these opinions if there were clearly set before him the certainty of ultimate unfortunate results to himself as well as to others. This process would be facilitated by the exchange of views made possible at association meetings.

From the industry's standpoint, therefore, the problem becomes the correlation of the necessary associations into a representative co-ordinating body and the direction of the combined effort in a manner that will insure such advantage to its members as is consistent with the rights of others and the best interest of the public. This correlation can be attained if the broad fundamental principles underlying the industry can be enunciated and if there can be developed therefrom the operating policies which the industry shou'd follow. The execution of this task requires the best minds of the industry.

To show how such correlation would assist in the development of the industry, President Berresford considered one very important problem in the electrical industry, namely, the ultimate dependence of industry on science and the consequent vital importance of research. While the hope of commercial gain will impel the continuance of applied research where it is already established, the speaker declared, fundamental research must be stimu'ated. An incentive must be offered to induce temperamentally fitted men to undertake this career and to become largely qualified, or else industry will go begging for the men it will need in increasing quantity for its applied research.

In this connection the Bureau of Standards, as a center of research, deserves particular consideration, Mr. Berresford maintained. If that body is to function most effectively and satisfactorily, industry must first agree on what the scope of the bureau shall be; second, educate the bureau in industrial conditions, and, third, by demanding that the interests of industry be heeded, insure adequate financial support for the bureau. This can be accomplished only by a united industry—commercial and non-commercial. The electrical industry, by reason of its greater interests, should initiate this work and carry forward through its associations the necessary process of education. The leaders in this work, said the speaker in conclusion, are the most competent to determine the fundamentals and policies by which this industry should be guided.

## *Development at Niagara Falls*

The progress of water-power development at Niagara Falls from its beginning to the present time was traced in a paper presented by John L. Harper and J. Allen Johnson of the Niagara Falls Power Company. Attention was directed chiefly to the recently completed development* known as Extension No. 3 and to the new work† undertaken by recent license from the Federal Power Commission. In brief this development involves running a 32-ft. (9.7-m.) U-shaped tunnel from above the falls to Extension No. 3, where additional generating capacity will be provided. To avoid exceeding the diversion allowed by treaty the least efficient equipment on the system—*i.e.*, at the Niagara plant—will be shut down. This development will utilize 220 ft. (67 m.) of the 314-ft. (95.7-m.) drop from the upper river to Lewiston and will ultimately add 187,000 hp. capacity to the system. The remaining 94 ft. (28.6 m.) can be developed in another plant farther down stream. A preliminary permit has been granted to the Lower Niagara River Power & Water Supply Company allowing two years for presenting plans to develop the lower river stage.

In the concluding portions of the paper by Messrs. Harper and Johnson emphasis was placed on the national benefits as distinguished from merely local benefits from developing Niagara power.

## *Advances in Hydraulic Design*

The tendency in hydro-electric practice, said W. M. White, Allis-Chalmers Manufacturing Company, is to develop each power site completely and to use larger units which will permit the maximum utilization of water power available. Where system interconnections exist each hydro-electric station is as much a unit in the system as was a single generator in old plants. Hence more freedom is afforded in selecting size of units. Steady advances are being made in speed of units, and no doubt even higher speeds will be adopted. For high-speed service Nagler wheels are giving excellent results. Regulation of speed, Mr. White said, can best be accomplished by making use of the inertia of rotating parts. The governing apparatus alone should not be expected to perform this function when all it can do is to open and close the turbine gates after being actuated by a change in turbine speed. However, modern governors are so sensitive that they will respond to a speed change of less than one-quarter of 1 per cent. Integral governors constitute one of the latest advances, and there is a tendency to simplify them further so that they will be self-contained.

The speaker expressed the opinion that the ideal runner material is bronze without any zinc, although cast steel has been used with excellent results for both high-head and intermediate-head units. Plate-steel runners and guide vanes have been recent innovations. In the design of guide vanes the trend is toward cast-steel vanes with integral stems controlled by outside operating mechanisms. Both concrete and cast-iron spiral casings are being used for low-head plants, the tendency being toward a circular cross-section. Mr. White pointed out that conversion of the velocity head of discharge into useful power can be accomplished by properly designing the draft tube, reference being made to some tests conducted with various kinds of regainers, including the hydraucone type.

Among other subjects discussed in the paper were the fastening of runners on shafts, support and guide bearings, and formulas for determining maximum runner speed, runner diameter and pressure changes in the hydraulic system.

*See ELECTRICAL WORLD, Sept. 18, Oct. 2, 16, 23 and 30 and Nov. 13, 1920.
†See ELECTRICAL WORLD, June 11, 1921.

## *Technical Committee Reports*

### ELECTRICAL MACHINERY

For some time the electrical machinery committee, B. A. Behrend chairman, has had under consideration proposed changes in the standardization rules relating to high-potential testing. These have become necessary in order to overcome the failure of the present rules to impose any test (1) between adjacent coils in any circuit of any phase and (2) between phase windings where the highest potential difference exists when the machine is operating. In addition, it is hoped to overcome the unknown stresses imposed at certain points owing to capacity effects in large machines. Work will probably be continued along this line.

### LIGHTING AND ILLUMINATION

In continuing its work of obtaining papers to be presented before the society the committee on illumination and lighting, C. E. Clewell chairman, expects to be able to present data on the subject of production intensities in industrial lighting as well as on glassware for street and commercial lighting. Among developments which were emphasized were the increased use of incandescent lamps, increase in industrial lighting, lighting demonstrations, highway lighting and the increased use of the foot-candle meter.

### PROTECTIVE DEVICES

Among the subjects taken up by the various divisions of the protective devices committee, D. W. Roper chairman, were current limiting reactors, system troubles, lightning arresters, circuit breakers and switches, and schemes of relay protection. As in previous years, the sub-committees carry over into the next fiscal year, and therefore the reports are in the nature of indicators of progress.

System troubles due to failure of relays to function properly came in for considerable study. It is pointed out that where relays are set in increments to protect different sections of a system the increments between different relays are frequently so large that a fault occuring near the source of power may throw the generators out of step. On the other hand, if the increments of settings are too small, sections beyond the fault are sometimes cut out of service. Need is felt for current-limiting feeder reactors to avoid the heavy drag on generators due to a fault near the station and which would allow wider increments between relay settings.

One interesting point made by a sub-committee is that the use of low-voltage releases on power-house auxiliaries is of questionable value. In case of low voltage on the main bus the plant auxiliaries may drop off and cause a complete shutdown of the plant. Lightning arresters have also been reported as being the cause of system troubles.

Lightning arresters were studied carefully in order to obtain the present practice of operating companies. One of the questions asked was that relating to choice of an arrester for a feeder circuit of 1,000 kw. capacity

on 10, 33, 66 and 150-kv. lines. Out of thirty-four companies reporting sixteen recommended the oxide-film arrester and fifteen the aluminum-cell arrester for such a line at 10 kv. For 33, 66 and 150 kv. the opinions are also about equally divided between the oxide and aluminum-cell arresters. There are two or three companies that believe in the use of horn gaps with resistors or Bennett type arresters for voltages above 10 kv. In a study of the omission of arresters in special cases twelve companies were found to believe that there are no cases where arresters should be omitted, while several companies hold that at small substations or on short unimportant lines or at points not subject to lightning the arresters might be omitted.

The sub-committee on circuit breakers and switches worked with the electrical apparatus committee of the National Electric Light Association and the power-switchboard and oil-circuit-breaker section of the Power Club. An abstract of the analysis of questionnaires on this subject will be found in the ELECTRICAL WORLD of June 4 on page 1314.

It has been the aim of the relay protection sub-committee to act as a clearing house for all information on protective relay schemes and to present this information in such a form that it will be an authoritative record of the progress of the art. Records which have been compiled indicate that the general trend is toward the selection of defective lines by means of the fault or trouble current rather than by relying altogether on the use of progressive time settings and current settings on the basis of the total current.

### ELECTROPHYSICS

One advance made in the electrophysics field during 1920 and 1921 was that by Rutherford on the atomic nucleus, the electrophysics committee, F. W. Peek, Jr. chairman, reported. Rutherford has bombarded the atoms of some of the lighter elements with alpha particles and has apparently succeeded in disintegrating them. Nitrogen was one of the elements thus disintegrated. Work and speculation on the arrangement of the electrons in atoms and molecules seem to be leading to something, and it is hoped that the results will be of great importance.

### TRANSMISSION AND DISTRIBUTION

Some of the subjects given particular consideration by the transmission and distribution committee, E. B. Meyer chairman, were increased voltages in underground cable work and also in outside-line transmission, power-cable testing and protection of cable systems. The cable research sub-committee, which had continued its co-operative work with the underground systems committee of the National Electric Light Association, pointed out that there had been a definite tendency toward the use of higher-voltage underground cables. In Chicago there will be installed 30 miles (48-km.) of three-conductor cable intended for a normal working pressure of 33,000 volts. This cable will have sector-shaped conductors each of 350,000 circ.mil. with $\frac{3}{16}$ in. (7.6 mm.) insulation around each conductor and a $\frac{7}{64}$ in. (2.8 mm.) outer belt, and the thickness of the lead will be $\frac{9}{64}$ in. (3.6 mm.). The over-all diameter will be about 2.95 in. (7.5 cm.), so that it can be installed in a 3½-in. (8.9-cm.) duct.

In regard to the crystallization of lead sheath it was declared that there is a direct relation between vibration and crystallization of the lead. Possibly crystallization has been caused by localized impurities or by lead becoming too cold in the die, although these points have not been definitely determined.

On standardization of cable ratings, some work has been done by the sub-committee and further investigations are in progress. There is a very evident lack of agreement as to the maximum permissible operating temperatures of paper-insulated cables, the committee reports. It may be possible, however, to prepare a tentative rating to show the permissible current for various maximum temperatures and then leave it to the user to determine the maximum temperature for his own cables.

### INSTRUMENTS AND MEASUREMENTS

Makers of watt-hour meters and demand meters have expended most of their effort during the past year in restoring pre-war quality of output, so that there has not been much development in instruments, according to the report of F. V. Magalhaes, chairman of the instrument and measurement committee. In the development work that has been conducted the principal attention has been directed toward apparatus for measurement of either kilovolt-amperes or the inductive component to be used in connection with rates, including power-factor charges. Makers of precision and recording instruments report the continued development and application of electrical measuring methods and instruments for recording and for the quantitative control of industrial processes. The definition of power factor in polyphase circuits which was being actively considered last year is in the hands of the standards committee.

### MARINE PRACTICE

Eight meetings of the marine committee, Arthur Parker, chairman, were held during the year, and sub-committees were appointed on American standards, appliances, editing, propulsion and auxiliaries. The final revision and passing of the recommended practice for electrical installations on shipboard has been completed and published by the Institute. A mass of information was collected dealing with the historical side of electric ship propulsion and electrical installations on shipboard.

### MINES

Automatic substations for mine service constitute one of the most important developments during the past year, the mines committee, Graham Bright chairman, reported. One plant has been in successful operation for several months and several more are being built. In the future the automatic substation will play a very important part in mine installations. The committee asserted its belief that the synchronous converter is becoming more popular each year for mine service, owing largely to the improvement in converter design which makes this apparatus as strong and simple to operate as the motor-generator set.

The electric hoist is rapidly replacing the steam hoist, wound-rotor induction motors with the magnetic type of control being used extensively. Development and application of magnetic control to mine locomotives has continued because the control has greatly simplified the tandem operation.

In metal mining one of the recent improvements has been the application of motor-driven turbo-blowers to cupolas, converters and flotation cells. These blowers require high-speed synchronous motors. Electric power is also gradually replacing steam on shovels and drag

lines where it is available. Car dumpers are said to be increasing in size from year to year, the largest car dumper yet constructed having been placed in operation recently at Baltimore.

The latest type of locomotive for quenching service in by-product coke-oven plants is equipped with electro-pneumatic control having not only automatic acceleration but also the ability to operate on any notch. It is believed that there will be a considerable call for the remote control of locomotives and cars in the future, not only around coke plants, but also where large amounts of materials are to be handled over fairly great distances.

### IRON AND STEEL

Much progress has been made in the most recent installations of reversing-mill drives and of adjustable-speed equipment for the lighter finishing mills. Control equipment of all kinds shows marked tendencies toward simplification, according to the committee on the iron and steel industry, of which W. F. James was chairman. In common with all industry, the iron and steel plants in many parts of the country will, on resumption of business, be confronted with the power problem, and much attention is being directed toward the development of dependable low-cost sources of electrical energy. Yard electrification is also being studied.

### POWER STATIONS

Considerable progress has been made in the designs of large power stations such as the Colfax power station in Pittsburgh, the Hell Gate station in New York City, the Delaware station in Philadelphia and the Calumet station in Chicago, according to the report of the power station committee, of which H. P. Liversidge is chairman. In the use of auxiliaries there is a decided trend toward electric drive. A number of improvements in design, construction and operation of turbines have been made, in which a more careful selection of material, closer inspection and improved testing facilities have been an important factor.

Operating reports during the year demonstrate the value and the greatly extended use of the oil conservator with large and high-voltage transformers, and there is a decided tendency toward simplification in station layout and details of design. Complicated switching connections to take care of possible contingencies have been replaced by simpler layouts, resulting in reduced costs and marked reduction in operating troubles. A radical departure in the arrangement of buses and switch-house connections is incorporated in the designs of the new Calumet station of the Commonwealth Edison Company, Chicago, and the Hell Gate station of the New York Edison Company. The principle is to separate the phases of each circuit, putting them into what are virtually separate rooms.

The most important development in oil circuit breakers has been in the extremely heavy-duty type. The latest designs are for units having a rupturing capacity approximately twice that of any previous breakers constructed, or 58,000 arc-amperes at 15,000 volts.

Changes in the design and application of reactors are said to have made these more satisfactory for present service conditions. Several companies have during the last few years prepared detailed operating instructions for their operating and maintenance attendants covering the operation of transmission and station equipment. Concluding the report there is a very complete bibliography of important articles on power-station design and operation which have appeared recently in American and foreign technical journals.

### INDUSTRIAL AND DOMESTIC POWER

Considerable advance has been made by the incorporation of safety features in both motor and control appliances, especially the latter, A. G. Pierce, chairman of the industrial and domestic power committee, asserted in his report. The use of 50-deg. motors as compared with those of the older 40-deg. ratings has increased, and there is evidence of much more accurate study of the power required to drive machinery and a closer selection of the motors to do the work. During the past year a record was made in the number of electric main-roll drives put into service in steel mills, and improvement has been shown in the accuracy and speed of control provided and especially in the magnetic types.

An interesting development in the application of individual drive to a series of machines for starching and drying cloth in textile mills is reported. Three independent rolls, each driven by an individual motor, were tied together by automatic-control equipment that insures the same speed of the fabric throughout the three machines. A new form of sectionalized motor drive for paper machines has been developed, each section being driven by an independent motor, the speed of which with relation to the speed of the other sections may be regulated to suit the requirements and when once adjusted will retain this relationship as positively as though geared together. A unique installation in the lumbering industry consists of a combined outfit of electrically operated yard and loader hoists.

### TELEGRAPHY AND TELEPHONY

Important progress has been made within the past year in telegraph and telephone departments of railroads, Donald McNicol, chairman of the telegraphy and telephony committee, reported. Considerable advance has also been made in protecting against lightning disturbances, inductive interference and electrolysis. The application of automatic printing telegraph systems to commercial requirements is being extended, a noticeable tendency being the gradual standardization of apparatus and of methods. The problem of inductive-interference control and reduction is now recognized to be of mutual concern. The trend is clearly toward co-operative study and treatment. In radio communication there has been a reorganization of ownership and of the important patent rights which should relieve a very complicated situation and result in placing in use equipment superior to that heretofore employed. Trans-oceanic service has been further improved with a resulting increase in the volume of traffic handled and in the quality of service rendered.

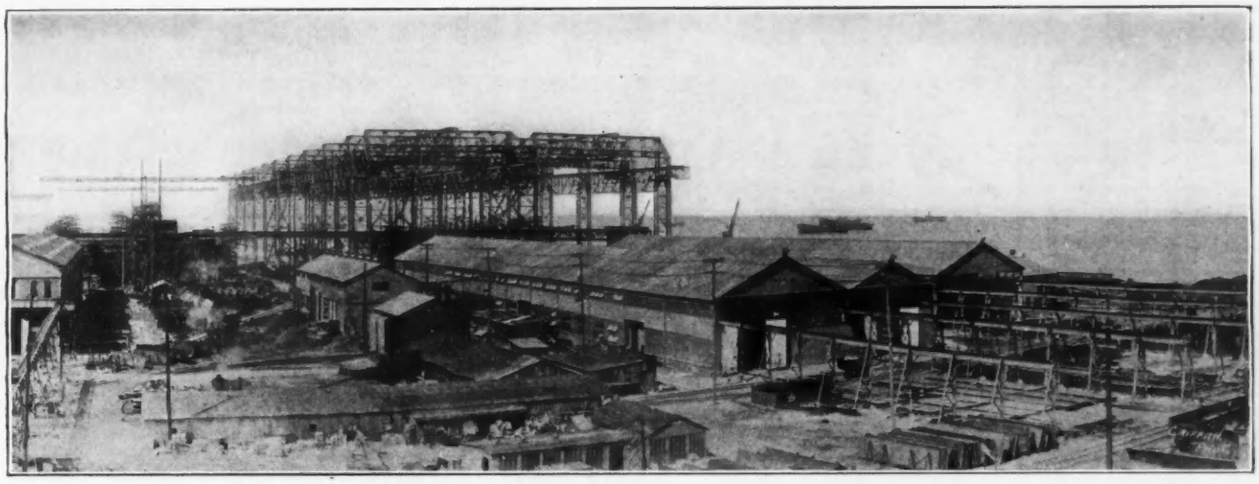
In radio telephony development has been in the direction of the application of the three-electrode tube to service as an amplifier delivering comparatively large power or to the problem of supplying radio service of a commercial character in connection with existing wire lines. Radio-telephone toll service is now in commercial operation, furnishing service between the island of Santa Catalina and the wire network of the mainland.

### TECHNICAL EDUCATION

The most noteworthy movement in technical education is greatly to increase investigational and research work in the colleges, according to the report of Prof. C. E. Magnusson, chairman of the educational committee.

# The Industrial Load in the Southern States

## Industrial Plants of This Section of the Nation Have Adopted Electric Service to a Marked Extent During the Past Decade—Seventy-five per Cent of the Electrical Energy Consumed Is Purchased from Central Station Systems



A PORTION OF THE YARDS OF THE NEWPORT NEWS SHIPBUILDING & DRY DOCK COMPANY, WHERE ELECTRIC SERVICE FINDS A WIDE APPLICATION

DURING the past decade the Southern States have made rapid strides in the use of electric service in all industrial processes. In 1914 the connected industrial load of the central generating stations of the South Atlantic and South Central States, exclusive of the lighting load, was only 572,900 hp. In the five succeeding years this load increased 121 per cent, or to 1,264,700 hp. The increase in the electrical energy sold to power customers by the central generating stations during this period was even more marked, increasing from 644,900,000 kw.-hr. in 1914 to 2,840,900,000 kw.-hr. in 1919, or 341 per cent. No statistics are available as to the increase in the operation of private generating plants in the Southern States during the same period.

General data are limited in value and must be supplemented by detailed statistics on the subjects making up the total. With this end in view the ELECTRICAL WORLD initiated a detailed country-wide survey to ascertain the extent to which electrical energy is now being used by the various industries of the nation. The investigation of the industries of California was completed last summer, and a detailed analysis of the industrial load in California appeared in the Aug. 28, 1920, issue of the ELECTRICAL WORLD.

The survey of the industries of the South includes the States of Virginia, North and South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Tennessee and Kentucky. About 8,500 questionnaires were sent out to the industrial plants in these states and 2,824 replies were received, of which 1,068 reported the use of electrical energy as the main source of power. The details of the results obtained from the survey are presented in Table I. Probably one of the most interesting portions of that tabulation is the section showing the source of electrical energy used by the companies reporting. The 1,068 plants using electrical energy reported private generators totaling 182,800 hp., which produced a total of 327,965,700 kw.-hr. during 1919. The electrical energy purchased by the plants reporting was only 478,450,627 kw.-hr. It should be pointed out in this connection that about 56 per cent of the industries generating all or a portion of their own electrical energy replied to the questionnaire sent out, while reports were received from only 32 per cent of the industries which purchased their electrical energy. On this basis the indications are that about one-fourth of the electrical energy used by the industrial plants of the South is still generated in private generating stations.

In the promotion of the electrical industry in the South certain of the electrical distributing companies offered special industrial power contracts in which the nature of the special service offered and the penalties for service interruptions were defined. Two classes of service were offered, namely, contracts for primary power and contracts for secondary power. One of the larger distributing companies defines "primary power" as meaning "such energy as the company agrees to furnish and supply every day in the year between the hours of 6 a.m. and 6 p.m., except when prevented by certain specified causes." "Secondary power" is defined as "such energy as the company agrees to furnish and supply eight months out of each consecutive twelve-month period of this agreement, and is such energy as the company reserves to itself the right to shut off and discontinue the supply thereof, by giving the customer twenty-four hours' notice of its intention to discontinue the supply, and being such energy as the customer agrees to resume the use of within twenty-four hours after the receipt by it of notice from the company that the company is ready to supply and furnish said energy to the customer, provided that the company shall not shut off and discontinue such supply during an agreement period of more than four months in each consecutive twelve-month period of this agree-

# Table I—Segregation of the Industrial Load in the Southern States

These data are compiled from an industrial survey being conducted by the McGraw-Hill Company, Inc., under the supervision of the Editorial Departments of the ELECTRICAL WORLD and *Power*, and cover plants in all industries employing over fifty operatives.

| State and Industry | Summary of Returns Received in Industrial Survey of the Use of Electrical Energy in Southern Industries | | | | | | | | | | | | | | "Electrical World" Estimate of the Total Electrical Energy Used in Southern Industries (Based on Survey and Census Data) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Companies Reporting | | Electric Generators | | | | Electrical Energy | | Motors Installed | | | Distribution of Drives | | | Electrical Energy | | Motors Installed | | | Distribution of Drives | | |
| | | | Direct-Current | | Alternating-Current | | | | | | | | | | | | | | | | | |
| | Total Number | Number Using Electrical Energy | Number | Total Rating, Hp. | Number | Total Rating, Hp. | Generated Kw.-Hr. | Purchased Kw.-Hr. | Number | Total Rating, Hp. | Number Under 5-Hp. | Belt | Chain | Direct or Geared | Generated Kw.-Hr. | Purchased Kw.-Hr. | Number | Total Rating, Hp. | Number Under 5-Hp. | Belt | Chain | Direct or Geared |
| **Virginia and North Carolina:** | | | | | | | | | | | | | | | | | | | | | | |
| Chemicals and allied products | 67 | 38 | 12 | 1,387 | 1 | 550 | 1,546,300 | 6,476,265 | 413 | 8,807 | 163 | 280 | 8 | 125 | 2,543,000 | 22,300,000 | 1,200 | 27,590 | 473 | 812 | 16 | 372 |
| Food and kindred products | 128 | 64 | 3 | 33 | 3 | 78 | 164,207 | 2,899,605 | 241 | 4,136 | 142 | 146 | 20 | 75 | 740,000 | 19,730,000 | 1,610 | 27,670 | 948 | 975 | 134 | 501 |
| Iron and steel, and their products | 60 | 45 | 13 | 4,086 | 1 | 25 | 5,768,424 | 36,419,633 | 2,777 | 58,036 | 321 | 1,655 | 44 | 1,078 | 7,000,000 | 37,850,000 | 2,960 | 61,830 | 342 | 1,764 | 48 | 1,148 |
| Lumber and its products | 94 | 27 | 12 | 1,240 | 6 | 5,015 | 35,545,400 | 8,745,220 | 429 | 13,266 | 54 | 306 | 13 | 110 | 40,000,000 | 54,500,000 | 930 | 28,430 | 117 | 662 | 30 | 238 |
| Metals and metal products other than iron and steel | 17 | 10 | 2 | 350 | 1 | 750 | 3,050,000 | 30,112,900 | 543 | 50,271 | 66 | 142 | 7 | 394 | 3,675,000 | 45,700,000 | 810 | 75,000 | 99 | 212 | 11 | 587 |
| Paper and printing | 15 | 10 | 7 | 385 | 0 | 0 | 4,560 | 864,754 | 109 | 1,698 | 77 | 101 | 1 | 7 | 2,795,000 | 4,640,000 | 910 | 14,140 | 642 | 843 | 9 | 58 |
| Stone, clay and glass | 33 | 26 | 8 | 364 | 3 | 1,600 | 7,348,620 | 1,435,589 | 164 | 6,856 | 34 | 83 | 3 | 78 | 9,000,000 | 9,110,000 | 340 | 14,140 | 71 | 172 | 6 | 162 |
| Textiles | 231 | 141 | 20 | 3,083 | 50 | 14,797 | 31,808,773 | 64,831,879 | 17,259 | 90,451 | 14,985 | 4,690 | 1,569 | 11,000 | 40,000,000 | 234,000,000 | 49,100 | 256,600 | 42,600 | 13,320 | 4,480 | 31,300 |
| Tobacco manufactures | 10 | 6 | 3 | 230 | 5 | 950 | 1,977,000 | 747,000 | 154 | 1,663 | 16 | 84 | 31 | 39 | 7,750,000 | 3,160,000 | 620 | 6,660 | 65 | 338 | 125 | 157 |
| Miscellaneous | 200 | 33 | 7 | 1,259 | 4 | 900 | 1,582,500 | 1,468,969 | 280 | 3,473 | 124 | 226 | 3 | 51 | 25,100,000 | 31,950,000 | 5,230 | 64,890 | 2,315 | 4,225 | 52 | 953 |
| Totals for Virginia and North Carolina | 855 | 398 | 87 | 12,408 | 74 | 24,665 | 88,795,784 | 154,001,814 | 22,369 | 238,657 | 15,982 | 7,713 | 1,699 | 12,957 | 138,603,000 | 462,940,000 | 63,710 | 576,950 | 47,672 | 23,323 | 4,911 | 35,476 |
| **South Carolina and Georgia** | | | | | | | | | | | | | | | | | | | | | | |
| Chemicals and allied products | 204 | 51 | 13 | 201 | 7 | 1,800 | 5,276,000 | 20,180,740 | 638 | 22,354 | 137 | 499 | 16 | 123 | 5,500,000 | 36,400,000 | 1,040 | 36,480 | 223 | 812 | 28 | 200 |
| Food and kindred products | 140 | 31 | 4 | 455 | 0 | 0 | 1,697,700 | 5,884,800 | 241 | 1,521 | 110 | 188 | 12 | 41 | 1,750,000 | 17,430,000 | 1,300 | 8,210 | 592 | 1,012 | 77 | 211 |
| Iron and steel, and their products | 64 | 37 | 15 | 15,606 | 6 | 3,702 | 8,768,900 | 6,952,351 | 826 | 21,709 | 206 | 414 | 15 | 397 | 13,980,000 | 11,270,000 | 1,330 | 34,880 | 332 | 665 | 27 | 638 |
| Lumber and its products | 76 | 15 | 2 | 464 | 5 | 2,117 | 441,000 | 1,508,160 | 208 | 4,772 | 30 | 167 | 0 | 41 | 2,068,000 | 2,020,000 | 440 | 10,010 | 63 | 353 | 0 | 87 |
| Metals and metal products other than iron and steel | 7 | 5 | 0 | 0 | 1 | 168 | 1,834,000 | 946,000 | 44 | 1,035 | 8 | 41 | 2 | 1 | 2,000,000 | 19,220,000 | 180 | 4,170 | 33 | 168 | 8 | 4 |
| Paper and printing | 4 | 3 | 0 | 0 | 2 | 800 | 2,000,000 | 5,250,000 | 60 | 3,447 | 5 | 45 | 0 | 15 | 2,465,000 | 8,280,000 | 90 | 5,120 | 8 | 68 | 0 | 22 |
| Stone, clay and glass | 33 | 14 | 0 | 75 | 4 | 1,625 | 7,528,250 | 844,718 | 114 | 4,506 | 21 | 102 | 0 | 11 | 6,000,000 | 12,000,000 | 250 | 9,680 | 46 | 224 | .... | 26 |
| Textiles | 202 | 110 | 27 | 1,753 | 41 | 24,190 | 69,319,817 | 109,776,169 | 4,551 | 76,454 | 1,492 | 2,234 | 963 | 1,354 | 89,800,000 | 251,000,000 | 8,350 | 140,530 | 2,736 | 4,100 | 1,768 | 2,482 |
| Tobacco manufactures | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,800 | 1 | 5 | 0 | 1 | 0 | 0 |
| Miscellaneous | 218 | 5 | 1 | 75 | 2 | 150 | 46,000 | 269,820 | 55 | 857 | 18 | 47 | 5 | 4 | 1,634,000 | 4,310,000 | 1,030 | 16,130 | 336 | 879 | 80 | 71 |
| Totals for South Carolina and Georgia | 948 | 271 | 63 | 18,629 | 68 | 34,552 | 96,911,667 | 151,612,958 | 6,737 | 136,655 | 2,027 | 3,737 | 1,013 | 1,987 | 123,197,000 | 371,936,800 | 14,011 | 265,215 | 4,369 | 8,282 | 1,988 | 3,741 |
| **Florida and Alabama:** | | | | | | | | | | | | | | | | | | | | | | |
| Chemicals and allied products | 63 | 25 | 8 | 421 | 7 | 1,363 | 1,575,250 | 2,413,358 | 159 | 5,542 | 75 | 125 | 8 | 26 | 1,820,000 | 16,550,000 | 730 | 25,440 | 344 | 575 | 46 | 109 |
| Food and kindred products | 37 | 16 | 0 | 0 | 0 | 0 | 0 | 2,189,100 | 133 | 1,745 | 85 | 81 | 5 | 47 | 1,670,000 | 23,750,000 | 1,540 | 20,250 | 984 | 938 | 59 | 543 |
| Iron and steel, and their products | 46 | 27 | 11 | 3,950 | 2 | 185 | 10,193,000 | 25,840,468 | 876 | 29,740 | 248 | 370 | 13 | 493 | 20,500,000 | 88,750,000 | 2,350 | 80,010 | 667 | 996 | 24 | 1,330 |
| Lumber and its products | 82 | 14 | 6 | 250 | 3 | 2,155 | 931,000 | 406,530 | 143 | 2,790 | 23 | 71 | 3 | 69 | 2,053,000 | 5,670,000 | 830 | 16,110 | 133 | 412 | 17 | 401 |
| Metals and metal products other than iron and steel | 34 | 14 | 4 | 280 | 5 | 7,850 | 3,489,000 | 5,662,000 | 335 | 10,474 | 151 | 114 | 25 | 196 | 4,000,000 | 21,320,000 | 820 | 25,600 | 370 | 279 | 61 | 480 |
| Paper and printing | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 63,000 | 12 | 25 | 10 | 9 | 0 | 3 | 4,000 | 9,280,000 | 650 | 16,490 | 314 | 488 | 0 | 162 |
| Stone, clay and glass | 17 | 9 | 1 | 7 | 0 | 0 | 6,000 | 1,583,500 | 38 | 1,425 | 0 | 28 | 0 | 10 | 4,800,000 | 32,100,000 | 880 | 33,030 | 132 | 648 | 0 | 232 |
| Textiles | 48 | 29 | 9 | 2,520 | 10 | 5,605 | 20,173,360 | 31,379,435 | 1,892 | 16,146 | 1,310 | 446 | 46 | 1,400 | 24,310,000 | 97,400,000 | 3,990 | 34,010 | 2,760 | 940 | 100 | 2,950 |
| Tobacco manufactures | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 489,000 | 30 | 320 | 6 | 18 | 4 | 8 |
| Miscellaneous | 4 | 3 | 3 | 615 | 1 | 180 | 1,005,000 | 174,000 | 42 | 844 | 7 | 33 | 0 | 9 | 29,000,000 | 101,000,000 | 7,330 | 92,960 | 2,475 | 5,760 | 0 | 1,570 |
| Totals for Florida and Alabama | 335 | 139 | 42 | 8,043 | 28 | 17,338 | 37,372,610 | 69,711,391 | 3,630 | 68,731 | 1,909 | 1,277 | 100 | 2,253 | 88,157,000 | 396,309,000 | 19,150 | 344,220 | 8,185 | 11,054 | 311 | 7,785 |
| **Mississippi and Louisiana:** | | | | | | | | | | | | | | | | | | | | | | |
| Chemicals and allied products | 58 | 6 | 7 | 288 | 12 | 4,320 | 18,600,000 | 145,300 | 111 | 6,023 | 32 | 25 | 3 | 80 | 23,330,000 | 23,800,000 | 290 | 15,470 | 84 | 65 | 16 | 209 |
| Food and kindred products | 54 | 11 | 17 | 381 | 9 | 2,357 | 18,423,040 | 553,121 | 728 | 20,836 | 158 | 469 | 29 | 230 | 21,130,000 | 7,380,000 | 1,090 | 31,300 | 236 | 702 | 44 | 344 |
| Iron and steel and their products | 16 | 5 | 4 | 393 | 0 | 0 | 1,311,200 | 1,325,000 | 320 | 4,682 | 125 | 208 | 7 | 105 | 1,432,000 | 2,560,000 | 480 | 7,106 | 191 | 318 | 11 | 161 |
| Lumber and its products | 146 | 29 | 17 | 1,335 | 14 | 5,764 | 16,173,030 | 1,307,967 | 584 | 7,579 | 136 | 376 | 9 | 199 | 56,900,000 | 8,200,000 | 2,170 | 28,230 | 505 | 1,397 | 33 | 740 |
| Metals and metal products other than iron and steel | 5 | 2 | 3 | 375 | 0 | 0 | 216,000 | 18,000 | 75 | 541 | 3 | 74 | 0 | 1 | 221,000 | 268,000 | 160 | 1,129 | 6 | 158 | 0 | 2 |
| Paper and printing | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 474,700 | 40 | 437 | 15 | 39 | 0 | 1 | 3,000 | 3,630,000 | 310 | 3,353 | 116 | 302 | .... | 8 |
| Stone, clay and glass | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45,000 | 663,000 | 12 | 519 | 2 | 8 | 1 | 3 |
| Textiles | 26 | 9 | 0 | 0 | 3 | 500 | 3,200,000 | 8,769,000 | 148 | 3,548 | 35 | 106 | 4 | 38 | 6,180,000 | 9,220,000 | 191 | 4,578 | 45 | 137 | 5 | 49 |
| Tobacco manufactures | 2 | 2 | 1 | 76 | 0 | 0 | 3,300 | 10,400 | 11 | 37 | 8 | 4 | 3 | 4 | 3,300 | 10,400 | 11 | 37 | 8 | 4 | 3 | 4 |
| Miscellaneous | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,930,000 | 10,720,000 | 1,630 | 20,605 | 550 | 1,204 | 188 | 238 |
| Totals for Mississippi and Louisiana | 330 | 67 | 49 | 2,848 | 38 | 12,941 | 57,926,570 | 12,603,488 | 2,017 | 43,683 | 512 | 1,301 | 55 | 658 | 118,174,300 | 66,451,400 | 6,354 | 112,327 | 1,743 | 4,295 | 301 | 1,758 |
| **Tennessee and Kentucky:** | | | | | | | | | | | | | | | | | | | | | | |
| Chemicals and allied products | 25 | 15 | 22 | 1,125 | 5 | 1,364 | 1,862,100 | 2,603,318 | 205 | 5,441 | 52 | 132 | 5 | 68 | 1,395,000 | 5,510,000 | 320 | 8,397 | 81 | 206 | 8 | 106 |
| Food and kindred products | 43 | 27 | 16 | 1,774 | 3 | 280 | 843,550 | 3,576,595 | 524 | 3,393 | 236 | 324 | 24 | 186 | 2,980,000 | 17,485,000 | 2,420 | 15,659 | 1,090 | 1,495 | 67 | 858 |

| | | |

current motors are used in the lumber industry, the voltage varying from 220 to 550, with a few 2,200-volt motor installations. It is estimated that 7,290 motors, with a total rating of 100,194 hp., are now in use by the lumber industry of the South; of which 1,588 are under five horsepower. About 72 per cent of the machines are belt-driven, 25 per cent are directly connected and only 3 per cent are chain-driven.

The principal machines in the lumber industry operated by electric motors are conveyors, planers, saws, molders, grinders, lathes, shapers, presses, drills, air compressors, cranes, pumps, dryers, fans, slashers, sizers, edgers, jointers and sorting tables.

*Textile Industry.*—The textile industry is by far the largest user of electrical service among the industries of the South. It is estimated that this industry consumed about 796,450,000 kw.-hr. of electrical energy in 1919, of which about one-fifth was generated in private plants. The large amount of energy generated in private plants appears to be the result of inability to obtain central-station energy owing to the isolation of the mill or the operation of an existing power plant for a part of the energy used and the purchase of the additional amount required. Very few textile mills are now installing their own generating plants if they are within reach of central generating-station service.

TABLE II—PRIME MOVERS IN THE INDUSTRIAL PLANTS OF THE SOUTHERN STATES

| State and Industry | Companies Reporting | | Waterwheels | | Internal Combustion Engines | | Steam Engines | | Steam Turbines | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total Number | Number Using Electrical Energy | Number | Rating, Hp. | Number | Rating, Hp. | Number | Rating, Hp. | Number | Rating, Hp. |
| **Virginia and North Carolina:** | | | | | | | | | | |
| Chemicals and allied products | 67 | 38 | 1 | 600 | 1 | 70 | 23 | 4,045 | 0 | 0 |
| Textiles | 231 | 141 | 110 | 12,036 | 1 | 85 | 38 | 13,809 | 16 | 27,417 |
| Iron and steel and products | 60 | 46 | 1 | 250 | 0 | 0 | 13 | 1,807 | 1 | 260 |
| Lumber and its products | 94 | 27 | 0 | 0 | 0 | 0 | 34 | 8,130 | 2 | 2,500 |
| Paper and printing | 15 | 10 | 1 | 300 | 2 | 250 | 3 | 675 | 0 | 0 |
| Food and kindred products | 128 | 64 | 4 | 86 | 1 | 300 | 19 | 638 | 1 | 100 |
| Stone, clay and glass | 33 | 26 | 0 | 0 | 0 | 0 | 16 | 5,390 | 3 | 2,450 |
| Tobacco manufactures | 10 | 6 | 0 | 0 | 0 | 0 | 10 | 1,825 | 0 | 0 |
| Metal and metal products other than iron and steel | 17 | 10 | 0 | 0 | 8 | 893 | 5 | 450 | 1 | 600 |
| Miscellaneous | 200 | 30 | 0 | 0 | 0 | 0 | 25 | 4,260 | 1 | 167 |
| Totals for Virginia and North Carolina | 855 | 398 | 117 | 13,272 | 13 | 1,598 | 186 | 41,029 | 25 | 33,494 |
| **South Carolina and Georgia:** | | | | | | | | | | |
| Chemicals and allied products | 204 | 51 | 2 | 250 | 0 | 0 | 17 | 3,145 | 7 | 3,000 |
| Food and kindred products | 140 | 31 | 0 | 0 | 3 | 23 | 19 | 2,200 | 0 | 0 |
| Iron and steel and products | 64 | 37 | 5 | 1,400 | 5 | 70 | 12 | 1,918 | 5 | 3,450 |
| Lumber and its products | 76 | 15 | 0 | 0 | 0 | 0 | 15 | 2,775 | 3 | 3,750 |
| Metal and metal products other than iron and steel | 7 | 5 | 0 | 0 | 0 | 0 | 1 | 225 | 0 | 0 |
| Paper and printing | 4 | 3 | 3 | 300 | 0 | 0 | 3 | 1,150 | 0 | 0 |
| Stone, clay and glass | 33 | 14 | 0 | 0 | 0 | 0 | 4 | 2,500 | 0 | 0 |
| Textiles | 202 | 110 | 56 | 26,629 | 0 | 0 | 65 | 39,245 | 19 | 11,340 |
| Tobacco manufactures | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Miscellaneous | 218 | 5 | 0 | 0 | 2 | 150 | 1 | 100 | 0 | 0 |
| Totals for South Carolina and Georgia | 948 | 271 | 66 | 28,579 | 10 | 243 | 138 | 53,258 | 34 | 21,540 |
| **Florida and Alabama:** | | | | | | | | | | |
| Chemicals and allied products | 63 | 25 | 0 | 0 | 2 | 200 | 17 | 3,100 | 0 | 0 |
| Food and kindred products | 37 | 15 | 0 | 0 | 0 | 0 | 5 | 441 | 0 | 0 |
| Iron and steel and products | 46 | 27 | 0 | 0 | 0 | 0 | 17 | 6,185 | 1 | 300 |
| Lumber and its products | 82 | 14 | 0 | 0 | 0 | 0 | 14 | 1,950 | 1 | 1,000 |
| Metal and metal products other than iron and steel | 34 | 14 | 0 | 0 | 0 | 0 | 5 | 830 | 3 | 500 |
| Paper and printing | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stone, clay and glass | 17 | 9 | 0 | 0 | 0 | 0 | 7 | 170 | 0 | 0 |
| Textiles | 48 | 29 | 20 | 7,350 | 0 | 0 | 13 | 12,415 | 8 | 7,466 |
| Tobacco manufactures | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Miscellaneous | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 972 |
| Totals for Florida and Alabama | 335 | 139 | 20 | 7,350 | 2 | 200 | 78 | 25,091 | 17 | 10,238 |
| **Mississippi and Louisiana:** | | | | | | | | | | |
| Chemicals and allied products | 58 | 6 | 0 | 0 | 5 | 4,200 | 16 | 2,341 | 1 | 1,250 |
| Food and kindred products | 54 | 11 | 0 | 0 | 0 | 0 | 33 | 8,770 | 6 | 9,225 |
| Iron and steel and products | 16 | 5 | 0 | 0 | 0 | 0 | 6 | 540 | 0 | 0 |
| Lumber and its products | 146 | 29 | 0 | 0 | 12 | 84 | 81 | 14,588 | 6 | 5,700 |
| Metal and metal products other than iron and steel | 5 | 2 | 0 | 0 | 0 | 0 | 3 | 675 | 0 | 0 |
| Paper and printing | 5 | 3 | 0 | 0 | 0 | 0 | 2 | 125 | 0 | 0 |
| Stone, clay and glass | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Textiles | 26 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tobacco manufactures | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 45 | 0 | 0 |
| Miscellaneous | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals for Mississippi and Louisiana | 330 | 67 | 0 | 0 | 17 | 4,284 | 142 | 27,084 | 13 | 16,175 |
| **Tennessee and Kentucky:** | | | | | | | | | | |
| Chemicals and allied products | 25 | 15 | 0 | 0 | 0 | 0 | 26 | 4,412 | 10 | 2,405 |
| Food and kindred products | 43 | 27 | 3 | 86 | 1 | 25 | 38 | 3,145 | 0 | 0 |
| Iron and steel and products | 65 | 41 | 0 | 0 | 0 | 0 | 73 | 11,885 | 6 | 5,093 |
| Lumber and its products | 65 | 12 | 0 | 0 | 0 | 0 | 9 | 1,478 | 0 | 0 |
| Metal and metal products other than iron and steel | 27 | 18 | 0 | 0 | 4 | 30 | 47 | 7,665 | 8 | 11,183 |
| Paper and printing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stone, clay and glass | 11 | 4 | 0 | 0 | 4 | 250 | 4 | 1,650 | 3 | 2,802 |
| Textiles | 73 | 59 | 5 | 540 | 0 | 0 | 36 | 9,438 | 0 | 0 |
| Tobacco manufactures | 7 | 3 | 0 | 0 | 0 | 0 | 2 | 400 | 0 | 0 |
| Miscellaneous | 40 | 14 | 0 | 0 | 0 | 0 | 25 | 4,710 | 1 | 60 |
| Totals for Tennesse and Kentucky | 356 | 193 | 8 | 626 | 9 | 305 | 260 | 44,784 | 28 | 21,543 |
| **Totals for the ten Southern States:** | | | | | | | | | | |
| Chemicals and allied products | 417 | 135 | 3 | 850 | 8 | 4 470 | 99 | 17,043 | 18 | 6,655 |
| Food and kindred products | 402 | 149 | 7 | 172 | 5 | 348 | 114 | 15,195 | 7 | 9,325 |
| Iron and steel and products | 251 | 155 | 6 | 1,650 | 5 | 70 | 121 | 22,335 | 13 | 9,103 |
| Lumber and its products | 463 | 97 | 0 | 0 | 12 | 84 | 154 | 28,921 | 12 | 12,950 |
| Metal and metal products other than iron and steel | 90 | 49 | 0 | 0 | 12 | 923 | 61 | 9,845 | 12 | 12,283 |
| Paper and printing | 28 | 18 | 4 | 600 | 2 | 250 | 8 | 1,950 | 0 | 0 |
| Stone, clay and glass | 94 | 53 | 0 | 0 | 4 | 250 | 31 | 9,710 | 6 | 5,252 |
| Textiles | 580 | 348 | 191 | 46,555 | 1 | 85 | 152 | 74,907 | 43 | 46,223 |
| Tobacco manufactures | 19 | 11 | 0 | 0 | 0 | 0 | 13 | 2,270 | 0 | 0 |
| Miscellaneous | 480 | 52 | 0 | 0 | 2 | 150 | 51 | 9,070 | 6 | 1,199 |
| Totals | 2,824 | 1,068 | 211 | 49,827 | 51 | 6,630 | 804 | 191,246 | 117 | 103,890 |

About 90 per cent of the motors now installed in this industry are of the squirrel-cage type. The voltage used varies over wide ranges, including 110, 220, 250, 440, 550, 600 and 2,200 volts. The size of the largest motors in textile mills varies from 1 hp. to 250 hp. with the smallest ranging from $\frac{1}{20}$ hp. to 3 hp. It is estimated that 64,111 motors are installed in the textile mills of the South, with a total rating of about 463,898 hp., and that 48,829, or more than three-fourths of these motors, are under 5 hp.

*Chemical Industry.*—Every Southern state reports extensive electrical operation in the chemical industry and its allied products. It is estimated that this industry consumed 139,148,000 kw.-hr. in 1919, of which 34,588,000 kw.-hr., or 24 per cent, was generated in private plants. This industry includes the making of dyes, potash, phosphates, gunpowder and all its derivitives, nitrates, chlorine, soda alkali products, acids and drugs and extracts of all kinds. The squirrel-cage motor is in general use in the chemical industry, with the wound-rotor motor used for variable-speed operations. The estimated number of motors in use in the chemical industry of the Southern States is 3,580, with a total rating of 113,377 hp. About 69 per cent of the machinery in use is belt-driven, 28 per cent is directly connected and only 3 per cent is chain-driven.

*Metal Industry.*—Metals and metal products other than iron and steel, which subdivision also includes mining of all kinds, are of large importance in certain of the Southern states, especially in Tennessee, Kentucky, Virginia and Florida. The motors used in the mining industry are as a rule of large rating, which accounts for the fact that the average rating of the motors reported by it is over 40 hp. and but one-fifth of the motors are under 5 hp.

Over 233,000,000 kw.-hr. of electrical energy is consumed annually by the iron and steel industries of the South. The motors, which are mostly belt-connected, are estimated to total 8,200, with an aggregate rating of 223,574 hp., and only about one-fourth are below 5 hp.

It would appear from a study both of the figures obtained from the survey and of the latest census figures available that the South is only in its infancy, electrically speaking. Great strides have been made during the past decade, but even a greater rate of growth may be expected as transmission systems are extended into the now insolated districts.

# Factors Affecting Long-Distance Bulk-Power Transmission

## Voltage Regulation of 220-Kv. Lines Can Be Insured by Proper Distribution of Synchronous Condensers—Several Promising Methods of Minimizing Insulator Destruction from Flashover—Necessity of Uniform Voltage Along the Line

SINCE a very large amount of power (100,000 kw. to 200,000 kw.) can be transmitted as far as 1,000 miles over one circuit at 220,000 volts, it is questionable whether any higher voltages will be required for national transmission systems, according to the paper which Frank G. Baum* presented this week at Salt Lake City before the American Institute of Electrical Engineers. This is particularly true because very large systems would demand at least two towers with four circuits to assure continuity of service. The speaker went on to say that so far as restrictions are concerned higher voltages might be adopted, but the economic limitations may be reached with 220,000 volts, when the value of standardization, the service insurance of multiple circuits, the amounts of power available at certain places and the demand of a given market are considered. If 220,000, 110,000 and 55,000 volts could be generally adopted, auto-transformation might be used economically. The frequency for such a standardized national electric power system should be 60 cycles, since this is generally advantageous for generation, transformation and distribution. Although it has generally been assumed that this frequency is disadvantageous for long transmission lines on account of voltage regulation, experience has shown that all requirements can be successfully met.

The insulation problem, Mr. Baum said, reduces itself to working to certain unit stresses, mechanical and electrical, and to the maintenance of certain factors of safety throughout the entire line structure, which includes insulators, towers, switches, transformers, etc. This factor of safety should be as permanent as possible, which means that the depreciation of the insulator should be virtually nil in service. This goal is being rapidly reached. While satisfactory potential distribution over insulator strings may be obtained at normal voltage by different methods of shielding or grading, further work along this line is desirable in order to crystallize the best methods into practical forms, so that the insulator manufacturers will be able to furnish the complete line-insulation equipment. Mr. Baum expressed the belief that 220,000-volt transmission is no more difficult than transmission at 110,000 volts or 175,000 volts, if due consideration be given to the unit air and leakage resistance stresses and if the insulation of the line is carried out sufficiently.

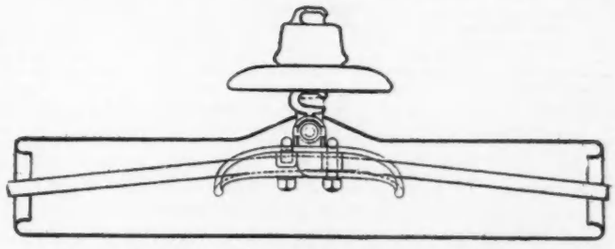


FIG. 1—AIR GRADIENT AT THE LINE END OF THE STRING IS IMPROVED BY A CYLINDRICAL SHIELD

For the successful operation of long transmission

*Consulting engineer, San Francisco.

lines it will be necessary to have virtually a uniform voltage along the line, not only for one load but for all loads. This voltage can be controlled within 3 per cent from no load to full load and with no greater variation for any points on the line. The standard transmission system must provide for power being supplied to the line and for loads to be taken off at certain points just as does a railway system. The system must be such that the power loads supplied to the line or taken from the line may vary, that the flow of power over sections may be actually reversed, or that the flow of power over the entire line may even be reversed without disturbing the voltage regulation necessary to give good service at all points.

By maintaining constant voltage along the line a number of troubles, such as voltage rise due to dropping loads, transformer variable ratios and voltage regulators, are abolished, and at the same time the insulation strain is reduced. Provision should be made for keeping the current and voltage virtually in phase at all points of the line. Mr. Baum pointed out that the 220,000-volt lines now being built are of extreme importance because of their effect on the transmission industry as a whole and on the practicable and is the only practical way of giving first-class service over long lines. Retransforming or regeneration schemes for long-distance transmission will not give such good service, and the shocks that come on the line are likely to be much greater than with the constant-potential system. Such a system of "loading" the transmission line to rotate the current through approximately the same angle as the pressure is rotated is comparable with the "loading" of long-distance telephones lines. This "loading" to maintain the current and voltage approximately in phase eliminates the question of the natural periodicity of the line, and hence the frequency may be selected independent of this point.

Such a system with say three or four circuits and synchronous condenser and switching stations every 100 miles to 150 miles (160 km. to 240 km.) may have automatic disconnection for any 100-mile section of each line without disturbing the service. Short circuits should be easily handled.

Since transformers can be designed so that increase of line voltage gives a very rapid increase of magnetizing current, they as well as the synchronous condensers will serve as auto-

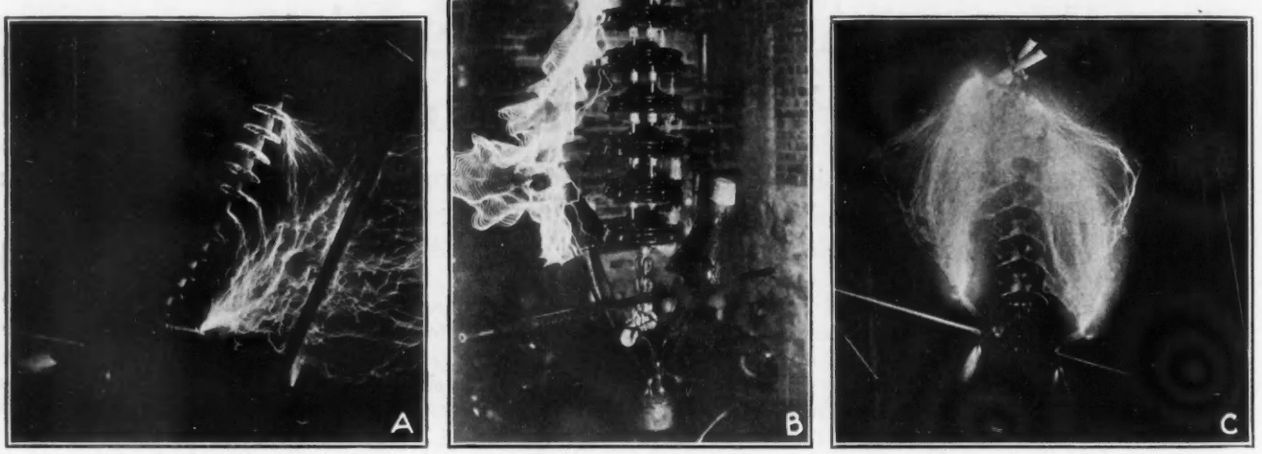



FIG. 2—FLASHOVER TESTS SHOW THAT THE POTENTIAL OF THE UPPER THIRD OF INSULATOR STRINGS SHOULD BE INCREASED ABOVE THE AIR POTENTIAL TO PREVENT THE ARC FROM STRIKING IN AT THESE UNITS

*A* and *C*—Note the bowing-out of flux lines and breakdown to the upper units. *B*—Wet flashover of disk-insulator string with horn insulators having tinfoil caps. The combination effects a greatly improved electric field.

service that is given by the company erecting them.

A voltage regulation diagram for a 200-mile (320-km.), 220,000-volt line for 400 amp. was worked out in the paper. It was shown that without synchronous condensers the generator voltage would have to be 157 per cent of the receiver voltage for a load with a power factor of 0.95. At no load the generator voltage would be about 86 per cent if all charging current were carried by the generator. Even for non-inductive load the generator voltage at full load would have to be raised 36 per cent above the receiver voltage. Such a generator would be very expensive. Restricting the generator voltage increase to 10 per cent to make up the dissipated energy on the line requires synchronous condensers of about 80,000 kva. at full load, but about one-half this amount is required to correct the power factor of the load. It is thus shown that it is impossible to transmit power over long distances and give satisfactory service without synchronous condensers.

Such a system of constant-potential transmission is matic magnetic brakes against increases in voltage. Corona loss, increasing with voltage if size of wire is chosen near the corona point, will also automatically act against increases of speed and voltage.

In dealing with the insulation of transmission lines the following points must have consideration:

1. The air insulation strength.
2. The porcelain insulation and mechanical strength.
3. The voltage distribution.
4. The leakage resistance gradient over the surface of the insulators.
5. Insulation of switches, transformers, etc.
6. Wet and dry arc-over of line insulation.

F. W. Peek, Jr., has shown that it requires only about 3 in. (7.6 cm.) of air between 10-in. (25.4-cm.) spheres to prevent breakdown for 130,000 volts to ground, it was pointed out, which is about the voltage to ground for a 220,000-volt line. More than 6 ft. (1.8 m.) from wire to ground at the towers, with 15 ft. (4.6 m.) between wires in the span, is being used, but without

getting the factor of safety commensurate with the distance. Regarding the line-clamp fittings and insulator pin of the first unit, the air gradient is very high owing to small diameters, angles of bolts, fittings, and also to the small pin of the bottom insulator. When excess voltages come on the line they pile up at the line-wire insulator units and break down the air at the metal fittings. This breaks down the air where it is highly stressed at the line fittings, and the air breaks down serially from one unit to another by transferring the high electric stress from one to another in the string. Corona also forms acids which attack the metal fittings. It is necessary to prevent incipient corona pluming or arcs at the insulators, said Mr. Baum, if the transmission line is to be fully successful—by which is meant that the insulation of the line must be such that the line should give as good operating results as the transformers or other transmission apparatus. Of course, the line is subject to damage maliciously done or due to accident, but, neglecting these, the line should be made as reliable as the remainder of the system.

Porcelain when well made is a good insulator, but the metal fastenings to the "cap-and-pin" disk types of insulators add a mechanical depreciation factor because expansion and contraction are not the same for porcelain and metal parts and for the cement used to fasten the parts together. By careful manufacture a tough porcelain can be made, in which depreciation from expansion and contraction can be much reduced. Careful selection and working of the clay and sufficient time in firing give a very high-class insulator product. In the link type of fastening the mechanical depreciation from expansion and contraction is very largely reduced, but in the types now made there is a restriction due to small diameters, and it is necessary on high-voltage lines to shield the links—at least those in the lower part of the string.

The prevention of depreciation due to expansion and contraction is largely a matter of cost, and as it is a slow process and since there is a factor of safety in the number of units in the string, the mechanical failure from the above causes may be dismissed as not affecting good service with good inspection.

From the voltage gradients for cap-and-pin insulators and also for the link type it may be seen that the total pressure is divided very unevenly among the units. In the cap-and-pin string of fourteen units the volts on the line unit are about 25,000, or about two and one-half times the average, but about six times the volts on the units near the ground end. In the link type there is even a worse case of distribution of pressure, the maximum being about 37,000, or four times the average and about ten times the stress on the units nearer the ground end of the string. This unequal stress on the units also causes unequal stress on the air, but, most important, it does not distribute the leakage stresses along the string uniformly. The maximum air and leakage stresses are from six to ten times the average. Reduction of the maximum stresses is therefore very important, and the result desired is that there will be more nearly average resistance stresses over the string.

Before a rational analysis of an insulator can be made the factors which limit the maximum stresses must be known. They are (1) the air stresses, (2) the leakage resistance stresses and (3) the insulator unit stresses.

The air stresses are known, and to control this factor the conductor must be enlarged at the insulator. The first controlling factor for satisfactory insulator characteristics, then, is that metal parts must be designed to give low air stresses at the line wire and also along the string of insulators, at least near the line-wire end.

The unit stress affects the leakage stress, and therefore it is very important also from this standpoint to reduce the maximum unit duties. The maximum leakage stress can be reduced (1) by reducing the unit voltage and (2) by enlarging the pin and by the design of the resistance path from metal to metal. The enlargement of the pin and the shield over the line wire also reduce the maximum voltage on units near the line. Taking care of these two points helps the grading of the units fairly well. The third factor, the grading of units, requires an understanding of the string gradient.

Satisfactory voltage distribution may be obtained (1) by use of ring shields, (2) by use of insulated horn shield, (3) by grading the lower one-third of the units and (4) by combining pin-type insulators at the line end with disk-type insulators at the upper end of string.

The first and second methods are very similar and accomplish the result by control of the field, by reducing

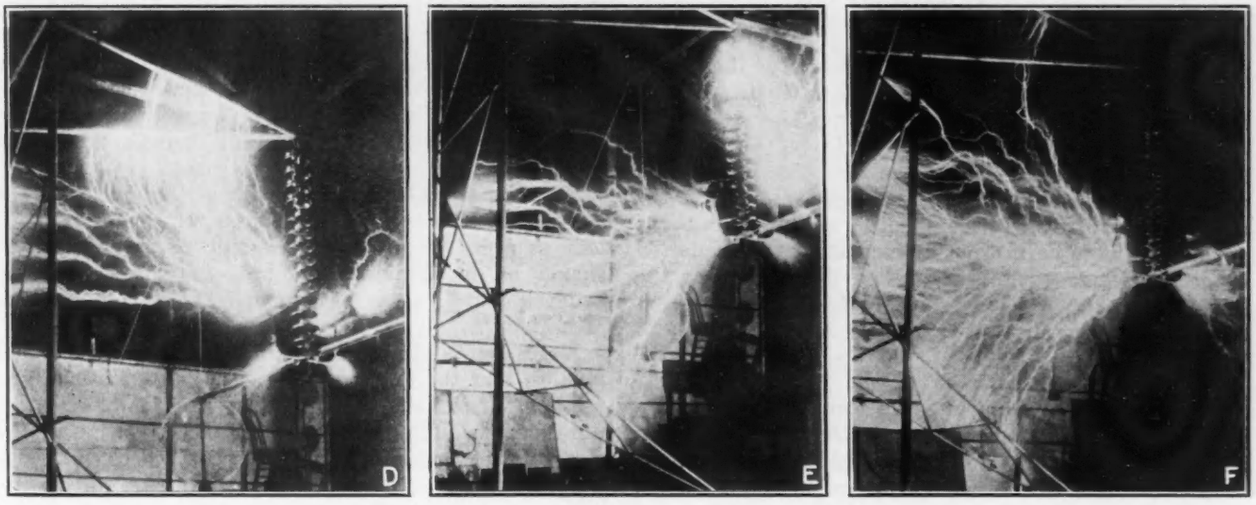



FIG. 3—HORIZONTAL SHIELDS AND VERTICAL SHIELDS CAPPED WITH INSULATORS IMPROVE THE FLUX DISTRIBUTION, CAUSING HIGH-FREQUENCY ARCS TO STRIKE TO THE TOWER

Where the insulator is omitted from a vertical shield (Fig. 3E) the arc strikes the upper insulators.

the current from metal parts of units to tower or ground and increasing the current from line wire to metal parts of the units. The disadvantage of raising the air potential above the units is that this also increases the currents from line wire to metal parts of insulator units and the dry arcs tend to break into the upper third of the string. By the use of the pin shields and line shields the height of the ring or horn shield may be reduced and part of the objection to the shields removed.

By the third method the potential of the string is kept as high as possible above the air potential, and hence it tends to prevent the arcs from breaking into the string. By using four large diameter units, with larger pins to increase the electrostatic capacity at the line-wire end, and by using the line shield, a very simple string is obtained. It is possible to use the four large units and a low ring or short insulated horn shield to grade the lower two units further, if desired. The air-potential gradient from line wire to tower should be made as flat as possible as a steep gradient invites arcs. This means a long string, and the air potential due to the line wire should be as low as possible. By the fourth method the string potential is brought close to the air potential. This method has not been worked out practically.

It is suggested that insulator men will undoubtedly work out a satisfactory solution for the insulators near the line wire and reduce the leakage resistance stresses and the air stresses to less than one-half of those now prevailing on 110,000-volt to 175,000-volt lines. This is held to be necessary to give satisfactory operation.

With the ungraded string the factor of safety is at the tower end instead of at the line-wire end of the string. Each insulator string should be treated like the end windings of transformers, not by adding more turns (or adding more units), but by increasing the insulation or decreasing the voltage stress on the units near the line wire so that these can absorb the excess voltages due to switching, etc., without undue stress.

### SWITCHING APPARATUS PROBLEMS ON 220-KV. LINES

The very large amount of space required for the 220,000-volt substation switches, etc., makes it advisable to use outdoor apparatus so long as the total cost is less than where there is protection from the elements. Probably transformers and disconnecting switches can be more economically placed outdoors than in a building. But in the case of the oil switch a different conclusion may be reached on account of the fact that the enlargement of the bushings for outdoor use also enlarges the tanks more than is otherwise necessary, so that because of the increase in the bushing the cost of the switches for a given kva. capacity may vary somewhat as the square of the voltage, if all the elements of design are carried out consistently.

Thus, by keeping the 165,000-volt switch, when used on the 220,000 lines, dry and clean a greater factor of safety is attained than exists with the 220,000-volt switch when used outdoors. Since the 165,000-kva. switch will give all the rupturing capacity required, it will pay to use this type inclosed, if the cost of protecting it from the weather is less than the extra cost of the higher-voltage switches.

This factor does not arise in the case of transformers because the tanks are so large that the larger bushing cost is the only extra item to consider for the higher voltage. If the wet arc-over were increased by increasing the length and not the diameter, this would reduce the size of tanks.

The dry arc-over voltage of a fourteen-unit string insulator shielded with ring or insulated horn shields is about 700,000 volts, or 50,000 volts per unit. The arc clears the insulators fairly well but sometimes breaks into the upper third of the string. Under wet test the arc tends to follow along the string of insulators and the wet arc-over voltage is about 60 per cent of the dry arc-over value, or about 450,000 volts to 550,000 volts for fourteen units with precipitation of 0.2 in. (5 mm.) per minute.

### DIRECTING FLASHOVER AWAY FROM INSULATORS

The control of the wet arc, to keep it away from the string of insulators, is important. Tests have indicated that the arc can be controlled in direction and kept away from the string, the accompanying illustrations showing that the arc-over can even be directed to the lower cross-arm. This may be accomplished by hanging two insulator units properly spaced below the line wire and then adjusting a pointer on the lower arm to direct the arc. The theory is that the units below the line will become dirty and wet and the insulation depreciate as do the line units. The adjustment for the wet and dry arc to travel to the lower arm can be very close to the arc-over for the string. Instead of hanging the extra units from the line wire, they may be hung from the lower arm, about 2 ft. (0.6 m.) toward the tower from the line insulators. The wet and dry arc can by proper adjustment be made to clear the string. Instead of the insulators hung from the arm, a porcelain tube may be used to direct the arc. The result here is even more satisfactory than in the other two cases.

While the wet and dry arcs may be controlled as above, it is believed that this control should be used only as a final protection in certain places. The effort should be to eliminate the arcs entirely, and it is believed that this can be accomplished, except in cases of accident.

Mr. Baum is confident, from all his observations and studies, that the final complete success of power transmission, at voltages higher than can be handled by pin-type insulators, must come from the design of the metal fixture (including the line wire) in contact with the air and porcelain, so that the air gradient and leakage gradient will be reduced to low values, in order that there shall be no tendency for arcs to start and that the maximum unit and leakage resistance can also be reduced to low values. Corona should also be prevented on account of the formation of acids.

Double-string and dead-end insulator strings should be avoided wherever possible, and in place of these extra-strength units should be used to allow insulators to swing clear at angles as far as possible.

It is the peculiar characteristic of nearly all apparatus that it depreciates less when used in normal service than when taken out of service for part of each day. This is because the depreciation depends largely on the maximum range of temperature changes and the number of such changes or cycles in a given period. All electrical apparatus, including transmission lines, should be in constant service under conditions that will as nearly as possible cause the apparatus to remain in one condition.

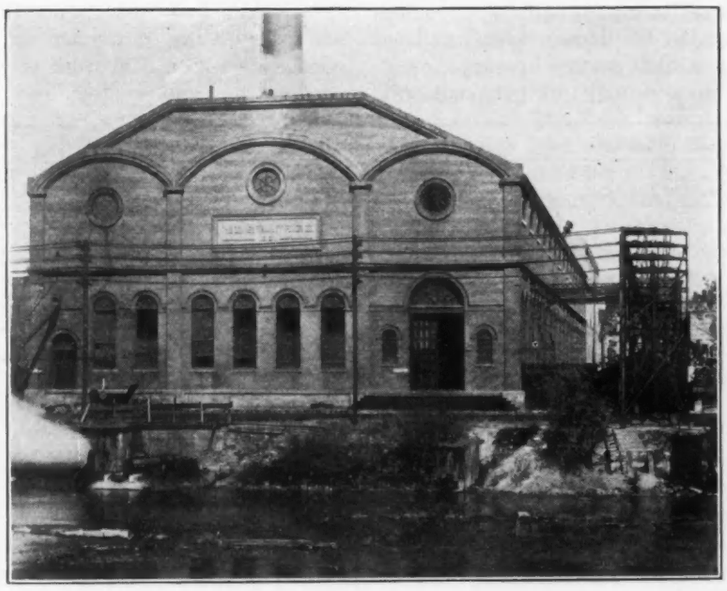
A system of transmission controlled as to voltage and insulated consistently by one of the methods described to give low air and resistance leakage stresses at all voltages will give service not possible on lines where these conditions are not carried out.

# Simple Methods of Economical Operation

## By Redesign Denver Utility Company Cuts Down Fuel Requirements—Economy from Careful Inspection of Equipment —Bonuses and Schooling Assure Co-operation from Employees

By C. H. McCLINTOCK
*Mechanical Engineer Denver Tramway Company*

THE steam-power plant of the Denver Tramway Company is interesting not from the standpoint of originality of design, but from the standpoint of what may be accomplished in the rehabilitation of an old plant. By replacing old equipment with modern units, by careful education of employees in economical operation and by adopting a bonus scheme in which all station employees share alike it has been possible to raise the thermal efficiency of the station from 8 per cent to 14.4 per cent. A 9,500-B.t.u. (5,270 cal. per kg.) Colorado lignite is burned successfully.



THROUGH REHABILITATION OF EQUIPMENT AND OPERATING METHODS THERMAL EFFICIENCY WAS INCREASED 80 PER CENT

The plant, which was built in 1901, conformed to the standards considered as modern engineering practice at that time, and later two turbo-generator units with boilers were added, so that up to 1916 the following apparatus was installed:

*Boiler Room:*

Thirteen 415-hp. Stirling boilers equipped with superheaters and Babcock & Wilcox chain-grate stokers.

An elaborate system of economizers with induced-draft fans.

Steam driven, reciprocating boiler-feed pumps.

Six 705-hp. Stirling boilers equipped with superheaters.

Green chain grates and individual economizers with induced-draft fans.

*Engine Room:*

Three 800-kw. General Electric direct-current generators directly connected to Greene-Wheelock cross-compound engines running condensing and served by jet condensers.

One 1,600-kw. General Electric direct-current generator directly connected to an Allis-Chalmers Corliss-valve cross-compound engine running condensing and served by a jet condenser.

One 1,500-kw. General Electric alternating-current generator directly connected to an Allis-Chalmers Corliss-valve cross-compound engine running condensing and served by a jet condenser.

One 2,000-kva. Westinghouse turbo-alternator served by a 6,000-sq.ft. (560-sq.m.) surface condenser.

One 2,000-kva. Westinghouse turbo-alternator served by a Le Blanc-type jet condenser.

Upon investigation it was found that such economies would be realized that it would pay to install a modern turbo-alternator of sufficient capacity to carry the full load and a 3,000-kw. rotary converter to take care of that part of the load formerly carried by the direct-current machines; consequently the new turbo-alternator and rotary converters were installed late in the summer of 1917. This change, due to the better water rate of the new turbine, automatically decreased the required boiler capacity so that the load could be carried on three of the 705-hp. boilers, and the thirteen 415-hp. boilers were subsequently dismantled and sold. It was also necessary to dismantle and scrap one of the 800-kw. Greene-Wheelock direct-current units in order to find room for the installation of the rotary converter. Thus the power plant as it stands today contains the following apparatus:

*Boiler Room:*

Six 705-hp. Stirling boilers equipped with superheaters, chain-grate stokers, economizers and induced-draft fans.

Two open feed-water heaters.

Three boiler-feed pumps.

*Engine Room:*

Two 800-kw. direct-current cross-compound reciprocating-engine-driven units.

One 3,000-kw. rotary converter.

One 1,600-kw. direct-current cross-compound reciprocating-engine-driven unit.

One 1,500-kva. alternating-current cross-compound reciprocating-engine-driven unit.

Two 2,000-kva. alternating-current turbo-generator units.

One 9,375-kva. General Electric Company turbo-alternator served by a 7,500-sq.ft. surface condenser and steam-turbine-driven circulating, condensate and vacuum pumps.

### IMPROVING FUEL AND WATER CONDITIONS

The fuel for the plant is purchased from the Leyden Coal Company and loaded at its mines, the Denver Tramway Company hauling it by means of electric locomotives to the plant. The coal is then unloaded into the track hopper, crushed and elevated by means of a continuous bucket conveyor to the bunkers overhead. Both slack and mine run are used. This coal is a Colorado lignite, high in moisture content and volatile matter, and has a heat content of 9,500 B.t.u. per pound

(5,270 cal. per kg.) as fired. It is burned well on the chain grate and has given very little trouble. However, the original Stirling arches have been replaced with flat arches over the stokers, this resulting in increased furnace efficiency and a decrease in maintenance cost.

The raw boiler-feed water is taken from an artesian well on the power-house property. This water is pumped into large storage tanks by means of an air lift, and from there it goes into the feed-water heaters. The water contains carbonate of magnesia, which separates out as a floury precipitate and, while not troublesome, requires the boilers to be "blown down" at least once a week, when the machines served by surface condensers are in operation and only 10 per cent raw

keeping the water at a proper level at the intake. The sheet-pile dam filled up virtually level-full with sand, and the sand coming down the river would fill up the intake and canals, necessitating continual removal by sand pumps. A gate was installed in the dam in such a position that when it was open the velocity of water past the intake was increased, and this cut the sand out. The situation has been so improved that the intake and canals do not now have to be cleaned out more than three or four times a year.

During the winter months, or low-water period, slush or "clinker ice" and slime float down the river. The ice stops up the intake screens and the slime coats the condenser tubes. In order to get rid of the ice on the screens the canal system has been so constructed that

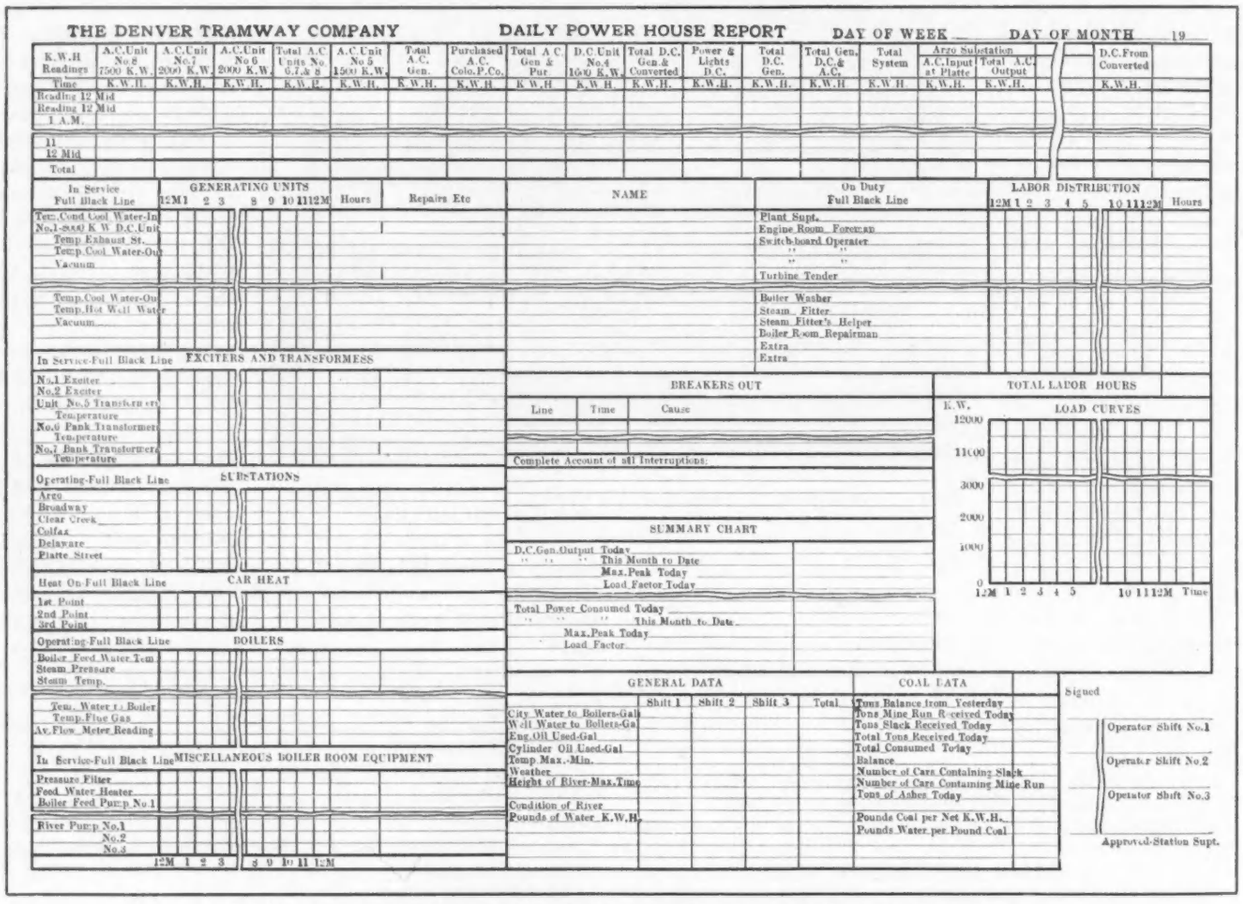



**FIG. 1—THE MAIN POWER-HOUSE REPORT HAS BEEN CONDENSED INTO ONE SHEET THAT GIVES ALL THE OPERATING INFORMATION NEEDED**

A record of meter readings is also kept, but the form is not reproduced here. The notable thing about the system is the total lack of complication. Complicated records do not spell economy, and the Denver Tramway Company has recognized this fact and depends upon its records to show results only. Those results are obtained by careful plant design and careful and intelligent daily operation, in which the full co-operation of the operating force is assured by careful training and recognition of efficiency.

make-up water is required. If the large turbo-generator is shut down for any length of time and all of the boiler-feed water is raw, the boilers are "blown down" once every twenty-four hours. If allowed to collect, the carbonate of magnesia will cause priming. The water does not coat the boiler tubes with any scale to speak of, and it is necessary to clean the boilers only once in six months.

The condensing water is taken from the Platte River and run into the power plant by means of a system of canals. An intake with screens was built on the side of the river, and a sheet-pile dam was "driven in" about 50 ft. (15 m.) downstream, for the purpose of

warm condensing water may be diverted to the intake to melt off the ice. The slime is removed by putting 50 lb. (22.6 kg.) of chloride of lime into the condenser once every two weeks. The slime is an organic substance, and the chloride of lime has the desired effect. When the river is high considerable fine sand is held in suspension in the water and passes through the condensers. This sand, instead of being a nuisance, has turned out to be a help, as it scours the condenser tubes and keeps them bright and clean.

A system of records, samples of which are shown in Figs. 1, 2 and 3, is used to keep track of the operation of the plant. In addition, such instruments as

Form 850 THE DENVER TRAMWAY COMPANY

Date_____

Daily Report of { Steam turbine No. 8 / Rating

Report by_____ Unit started_____ Shut down_____

LOAD READINGS

Time

Pressure: degree superheat of steam
First stage
Absolute
Pump
Bearings
Hydraulic Gear
Temperature: Return Oil
Generator end
Middle
Generator end
Temperature: Oil supply
Engine Room
Air in generator
Air out generator
Exhaust steam
Condensed steam
Cooling water inlet
Cooling water outlet
No. valves operating
Kilowatts
Volts
Amperes
Field excitation
Volts
Amperes
Power factor
Speed

INSPECTION

Condenser and Pump | Main Governor | Steam Seal | Oil Pumps | Bafflers | Strainers | Oil Filters

Oil Filters | Wheel Clearance | Brushes | Generator | Collector Rings | Emergency Governor | Cleanliness

REMARKS:

FIG. 2—TURBO-GENERATORS HAVE AN INDIVIDUAL REPORT FOR EACH DAY

recording economy draft gages, recording and indicating thermometers, steam-flow meters, indicating and recording pressure gages, and a $CO_2$ recorder are in use. The $CO_2$ recorder, however, is used only as a checking device and is not in continuous service on any one boiler. When the instruments show anything wrong at any locality the trouble is remedied as soon as possible. In addition, all apparatus is thoroughly inspected at regular periods and is continually checked up.

Each employee on the power-house payroll who has been in the service of the company one month or longer receives a bonus, which is figured from the coal rate per gross kilowatt-hour. This bonus is divided equally among the employees, 90 per cent being paid monthly and 10 per cent being retained by the company to be paid semi-annually to all men who have been on the power-house payroll for the half year or longer just preceding the date at which this last amount is paid. A skeleton of the table used follows:

| Coal per Kilowatt-Hour, Lb. | Total Bonus per Month | Coal per Kilowatt-Hour, Lb. | Total Bonus per Month |
|---|---|---|---|
| 3.10 to 3.09 | $2.00 | 2.71 to 2.69 | 422.00 |
| 3.01 to 2.99 | 32.00 | 2.61 to 2.59 | 652.0 |
| 2.91 to 2.89 | 112.00 | 2.51 to 2.49 | 932.00 |
| 2.81 to 2.79 | 242.00 | 2.41 to 2.39 | 1,262.00 |

From the complete table it is an easy matter for the office force as well as the men themselves to figure the bonuses. Another feature of the system is that all employees share alike in the bonus, thus eliminating the inclination of the men receiving the lowest pay to "lay down" on the job and throw all the responsibility of keeping up plant efficiency upon the shoulders of the chief operator and boiler-room foreman.

The bonus system has been in operation for more than three years now and has worked out satisfactorily to all concerned. Among many things it has promoted co-operation among the employees, as each one can see that individual negligence not only reflects unfavorably on the operating force as a whole but also tends to reduce the bonus.

In order that the men may feel that the company is as interested as they are in keeping the bonus large, a system of education was inaugurated. At first the men were brought together at regular intervals for the purpose of giving them lectures on the operation of a plant and methods for forestalling operating troubles. It was found that too much time was wasted by this method and too many imaginary troubles were cited. The method that is now used is to take up each trouble as it comes, correct it at the time and explain its cause, effect and method of correction to every man interested. Then if the same trouble comes up again every man knows how to remedy it.

The daily load curve of the plant is the typical and familiar street-railway curve—that is, two peaks, one in the morning and one in the evening, and a very light load from midnight till morning. Momentary peak loads of 10,000 kw. and hourly peak loads of 8,500 kw. are carried with an average yearly load factor of 45.9 per cent.

The over-all efficiency of boilers, superheaters, economizers and furnaces averages 71 per cent. Feed water consisting of 90 per cent condensate and 10 per cent raw "make-up" water is heated to a temperature of 150 deg. Fahr. (66 deg. C.) in the feed-water heaters before being pumped into the economizers. This is in order to keep the economizers warm enough to prevent hard soot deposits and corrosion due to condensation on the tubes of moisture in the flue gases.

Steam is delivered to the turbine and engine throttles at a gage pressure of 180 lb. per sq.in. (12.6 kg. per sq.cm.) and a total temperature of 450 deg. Fahr. (238 deg. C.). A back pressure of 1½ in. (3.8 cm.) of mercury is maintained in the turbine exhaust and 4 in. (10 cm.) in the exhaust of the engines.

Up to the summer of 1917 before the new 9,375-kva. turbo-generator was installed the coal rate of the plant was 4½ lb. (2 kg.) per gross kilowatt-hour, and since the installation the coal rate has been reduced to 2½ lb. (1.1 kg.), or 23,750 B.t.u. (6,000 cal.) per gross

Form 789

THE DENVER TRAMWAY COMPANY
CONDITION OF LOAD

Time 11 Date 19

| | Average Load | Maximum Peak | Machines in Service No. | Kw. | Capacity |
|---|---|---|---|---|---|
| A.C. generated at Platte | | | | | |
| D.C. generated at Platte | | | | | |
| D.C. converted at Delaware | | | | | |
| Total system load | | | | | |

_____ Hp. boilers in service
_____ " " " "
_____ " " banked
_____ " " "

Remarks_____

FIG. 3—CONDITION OF LOAD IS SHOWN IN THIS SIMPLE FORM

kilowatt-hour. Although not so efficient as some of the more modern and larger steam-power plants, a thermal efficiency of 14.4 per cent as obtained at the present time against 8 per cent which was formerly obtained shows what may be accomplished by the rehabilitation of an old plant.

## Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

### How the Central Station Can Help to Popularize Radio and Promote Customers' Good Will

*To the Editor of the* ELECTRICAL WORLD:

SIR: Without a doubt there is no electrical apparatus that has received so little consideration in the past from the public utility as radio-telegraph and radio-telephone apparatus. When some irritated customer in the vicinity of a young amateur with a small spark coil complains about his lights flickering the service man usually goes through the routine of investigation and then the matter is dropped.

Today not a few utilities are taking advantage of the radio art and are experiencing gratifying results. For the central-station company serving a large territory radio sets are proving to be a wonderful aid in cases of telephone interruption. Moreover, when transmission lines are in trouble the telephone is found in the same condition. Not only from the operative standpoint but from a business viewpoint radio supplies are in such demand that the electrical utility handling up-to-the-minute merchandise cannot afford to stand by uninterested and allow the local sales end of this business to be mishandled by non-technical men. Here is not only a field of good business but one of co-operation with those who are now promoting the wider use of radio.

Since the inauguration of the daily market quotations and market news letters by the federal Department of Agriculture wireless has come to mean more to the agricultural community than ever before. Right here is the opportunity of a lifetime for a central-station company to promote good will. Any utility serving agricultural districts would be amply repaid many times for the few minutes a day required to copy this class of information. The blanks needed are supplied without cost by the Bureau of Markets of the Department of Agriculture.

Many utilities will be surprised to learn that they do need to go outside of their present organizations to find operators for these stations. The electrical engineer will in many cases be a man who has mastered the basic principles of radio telegraphy and telephony, and he can generally be relied upon to assemble and install apparatus that will meet conditions existing.

Some hesitancy has been evident, perhaps on account of the license question. This is one of the most important factors in the installation of a system of radio communication. Operators to obtain a second-grade amateur license must be capable of receiving at least ten five-letter words a minute, Continental Code. They must have a fair working knowledge of the apparatus and also of the laws governing radio communication.

The most feasible method of arranging for the licensing of stations which are being put into operation is to obtain amateur station licenses. These will serve until the system has been put into satisfactory operating condition. Owing to the nature of the work with which public utilities are confronted, it is often desirable to use longer wave lengths than the 200 m. allowed to amateur stations. For this class of work the Department of Commerce is authorized to issue limited commercial licenses. Operators of a higher grade will be necessary, but the central-station company will be able to furnish more accurate and dependable service. No charges are authorized as none are necessary. Of course, the station is prohibited from communicating with commercial and other stations except in case of emergency. Detailed information on license requirements and laws is available in the "Laws Governing Radio Communication," obtainable for 15 cents from the Superintendent of Documents, Government Printing Office.

ORVILLE R. TOMAN,
Bedford Light, Heat & Power Company, Manager.
Bedford, Iowa.

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### "Electric Power Industry" Favored as Properly Descriptive Name

*To the Editor of the* ELECTRICAL WORLD:

SIR: At a recent meeting of division managers and department heads of one of California's power companies it was suggested that the public service corporations of the state be no longer referred to individually by that name, but that collectively they be distinctively referred to as an industry. There is no doubt sound psychology in this suggestion, which upon a little study may become more apparent. The public mind is constantly subjected to varied influences which after a time create more or less definite impressions, finally consolidating into a general belief which may be termed public opinion. Frequently these influences are of a sinister character and assume far reaching proportions. The corporation plan began to find favor in America about 1850 and was considered a step forward in the conduct of expanding business. The branch of industry engaged in the business of generating, distributing and delivering electrical energy came in later years, as did others engaged in transportation, communication, etc., to be known as a group of public utility corporations.

Now let us consider the meaning of these words, their fitness, the changes later adopted, and why the most recent change in name may have been suggested. "Public," of course, means the people. "Utility" means "quality of being capable of bestowing benefits to the greatest number." "Corporation" means "combined into one body." A public utility corporation, then, is an institution fully capable of usefulness and of bestowing benefits on the people, with all the necessary agencies for such accomplishments combined into one body.

As these agencies became more efficient and the corporations realized that their obligation to the public was to give real service, as implied by the word "utility," rather than the sale of a commodity, the name "public service corporation" came into being. All during this time we saw certain influences depict the corporation

as an opulent and corpulent individual, heartlessly preying upon the helpless. This, largely owing to a lack of real understanding on the part of the public, has unquestionably engendered a feeling of mistrust and disfavor.

The word "industry" seems to be agreeably accepted today by the majority, although perhaps not any better understood. The following would seem to define it: "Any department or branch of art, occupation or business which employs capital and labor and is a distinct agency for economic development and human advancement."

It is therefore resolved by the California Electrical Co-operative Campaign that in the future we refer to that industry which has contributed by the supply of electricity to the upbuilding of the state and the general advancement, prosperity and happiness of its people as the electric power industry.

ROBERT L. ELTRINGHAM,
Manager.

California Electrical Co-operative Campaign,
San Francisco, Cal.

## Need of Better Protection Against Improper Fusing of Circuits

*To the Editor of the* ELECTRICAL WORLD:

SIR: I was very much interested in reading the recent article by H. S. Rich regarding the refilling of fuses and a further discussion by Dana Pierce in the issue of April 30. I agree with Mr. Pierce in what he says relative to the misapprehension of what constitutes proper fusing. The fire hazard is greatly increased by the use of solder, plug fuses, iron wire, copper wire and copper pennies. I have seen cartridge fuses on 600-volt service that have been refilled with carriage bolts in place of proper fuse links. In my opinion more so-called electrical fires are due to improper fusing than to the use of the open knife switch. Several cases have come to my attention where fires have been directly due to this abuse, and an entrance cabinet which is not properly sealed and controlled by a person familiar with the dangers of improper fusing is not a "safe and sane" installation.

We have endeavored to convince city electrical departments of the desirability of sealing entrance switches and have been able to prove by reports of actual fires that few realize the hazard of not using proper fuses for the protection of electrical circuits. A person who willfully places anything other than the proper fuse in a cut-out is creating a condition that may mean a loss of property and possibly life. A glaring example of this practice came to the writer's attention when a fire in a local theater was reported as caused by defective wiring. An inspection revealed that twenty cut-outs were equipped with pennies as fuses. Here the improper fusing might have resulted in loss of life.

The use of the safety switch on meter services would seem to me undesirable, particularly on account of there being no convenient means for meter testing. Its application seems to be along industrial lines, its purpose being usually to open and close the circuit. Meters are rarely installed in connection with these switches, and arrangements do not have to be made for shunting the meter as in the case of meter-entrance switches. It is the writer's opinion that it is much more important to install inclosed-type switches in our industrial plants than on services, owing to the fact that they are handled very frequently and in a good many cases by persons unfamiliar with electricity. There is no question that this type of switch greatly reduces the accident hazard and prevents the operator from coming in contact with any live parts. In the case of an externally operated switch, which is sometimes misrepresented as a safety switch, being used, it would seem to me that to minimize the life hazard this switch should be sealed, in view of the fact that the operator is exposed to live parts when the cover of the switch is open. It has been the writer's experience that improper fusing is not so common in industrial applications as with meter-service installations. Undoubtedly this is due to the fact that in the former case responsible persons usually replace the fuses. The hazard is probably less on account of the main fuses furnishing additional protection, a condition which does not exist with many service installations.

I wish to quote from the National Electrical Safety Code with reference to the hazard of externally operated inclosed switches. Page 258, paragraph 324, reads:

> Where fuses are in locked cabinets (or otherwise made accessible only to qualified persons), sufficient protection is usually secured for all voltages if switches are provided to disconnect the fuses from all sources of electrical energy.
>
> When switches and fuses are inclosed in metal cabinets and live terminals are accessible, greater hazard exists than if they were not so inclosed, as the live terminals are adjacent to grounded metal.

The Travellers' Insurance Company, a noted authority on life hazards, advises that the safety switch should be so constructed that the door of the inclosed case cannot be opened unless the switch is in "off" position and the switch cannot be closed until the door has been shut. It is the belief of the writer that the various manufacturers could render valuable assistance to the electrical industry as a whole if they would advocate the sealing of entrance service cabinets and the installation of safety switches in connection with industrial applications. There is no question that the life and fire hazards are decreased by the use of inclosed, externally operated switches; but it is the writer's opinion that more "electrical" fires have been caused by improper fusing than in any other way. If we are to reduce to a minimum accident and fire losses from electricity, why not require the safest equipment and prevent unauthorized persons from tampering with the devices which are supposed to make it so?

J. C. LANGDELL.

Jackson, Mich.

## Electric Heating System on Swiss Railroads

*To the Editor of the* ELECTRICAL WORLD:

SIR: For the last few months the passenger cars on the Berne-Thoune section of the Swiss Federal Railways have been supplied with steam for heating from electrical steam boilers. The heating unit of the boiler takes current directly from the overhead line without transformation and converts it into heat. This is the first electrical steam boiler installation working directly at 15,000 volts. The apparatus supplying the electrical steam was built by Brown, Boveri & Company and is installed in an ordinary railroad baggage car especially arranged for this purpose. The maximum capacity of the boiler is 1,200 kw. A regulating device up to the minimum of 300 kw. has been provided. It is intended to introduce these heating cars on a larger scale on several lines of the Federal Railways.

HENRY L. GEISSEL.

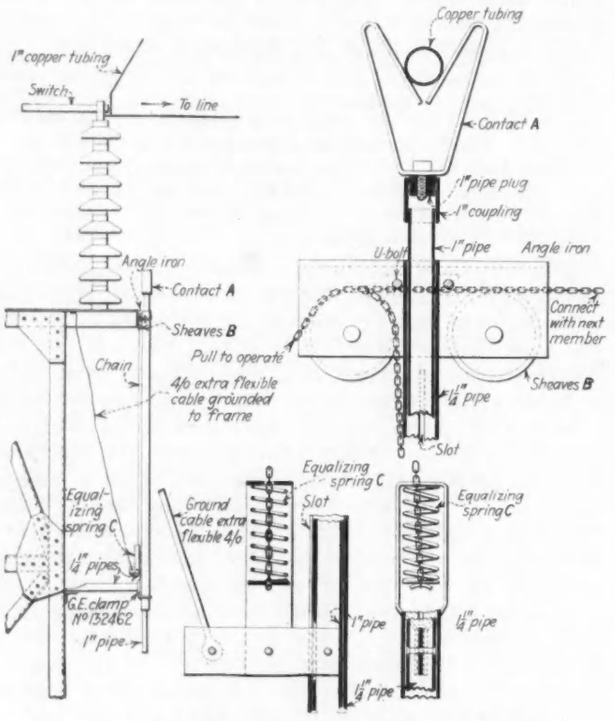
Beaurivage, Thoune, Switzerland.

# Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

## Remote Hand-Operated Grounding Switch

AS THERE was insufficient room on the roof of a certain 60,000-kv., 100,000-volt substation to permit the use of standard grounding devices, the mechanism described in this article was designed and so




LINE IS GROUNDED BY PULLING CHAIN TO RAISE CONTACT *A* UP TO LINE

installed that every incoming high-tension line could be grounded from the main switching floor. No special material is used in making up these ground switches, and when they were installed in 1917 each one cost about $150 per line complete and ready for operation. In most indoor substations it is necessary to send a man out on the roof either to ground the line or to see that it has been properly grounded, but with this arrangement the action is so positive that any line can be grounded from inside the substation without fear of a mistake.

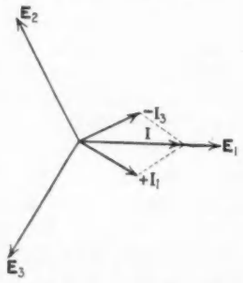
The grounding switch is constructed in the following manner: A 1-in. pipe 5 ft. long is made a sliding fit in a 1.5-in. pipe, both pipes being galvanized iron. The outer pipe, about 4 ft. long, is stationary and has a slot cut in its side. Connection is made to the inner pipe through this slot by means of No. 4/0 extra-flexible wire. The other end of the connection is grounded on the steel framework. At the top of the inner pipe is a copper contactor, *A*, which is pulled up against the incoming line by a chain and a steel wire which are connected to the inner pipe. The chain runs over a pulley and then passes through the floor to a small hand winch on the main switch floor of the substation. A second chain attached to the first passes to the next phase, which has a similar arrangement. From here a third chain passes to the next phase. Thus the grounding devices for the three phases of each line are operated from the one winch.

C. C. ROBINSON,
Superintendent of Electric Stations.
Union Electric Light & Power Company,
St. Louis, Mo.

## Single-Phase Meters Used on Three-Phase Power Service

READERS of the ELECTRICAL WORLD may be led to use an incorrect meter constant by following the article on page 712 of the issue for March 26. In case I of this article the registration is 50 per cent instead of 57 per cent as stated. When using three-wire meters it is well to observe that the total number of turns in a series coil is the same as in a single-phase, two-wire meter of the same rating, the only difference being that the turns are divided in two sections. On a balanced three-phase, 110-volt circuit at unity power factor, as represented in the article, the phase relations are shown in the accompanying diagram. The effective current is readily seen to be the $\sqrt{3}I$ which is in phase with the voltage applied to the meter. The apparent watts, of course, are $3I \times 110$, but owing to the fact that the turns in each set of series coils are only one-half those of a single-phase, three-wire meter, the watts as registered by the meter would be only $(\sqrt{3}/2)EI$.

Now the true power is $\sqrt{3}EI$ under the condition stated so that the ratio of the true power to that shown by the meter is $\sqrt{3}EI \div (\sqrt{3}/2)EI = 2$. Therefore, if a single-phase, three-wire meter is used on balanced three-phase loads, the dial reading must be multiplied by the factor 2 in order to obtain the true energy delivered. It can readily be demonstrated that the meter registers correctly on any power factor if the load is balanced.

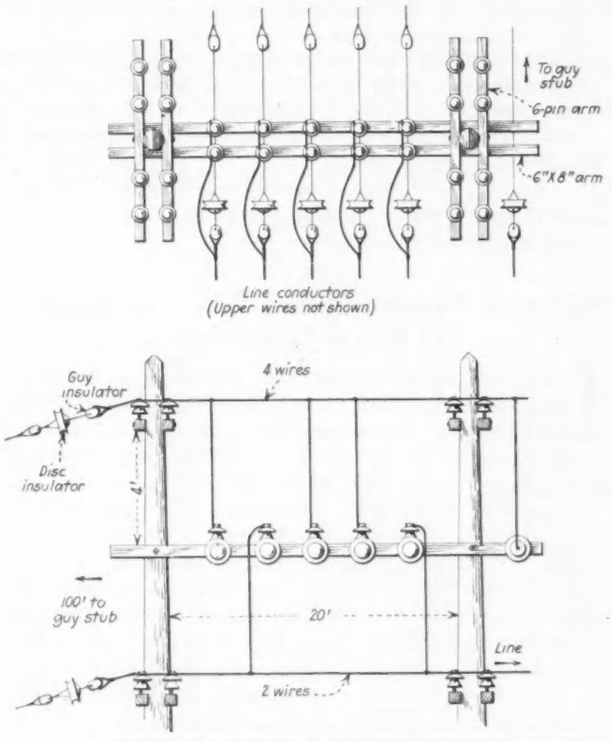



RELATIONS OF CURRENT AND VOLTAGE IN A WATT-HOUR METER

When such meters are supplied for operating on three-phase balanced loads, the register ratio is made just one-half that of a standard three-wire meter of the same rating and the use of a constant is thereby eliminated.

## Double-Pole Corner for Heavy Lines

HEAVY cable corners that provide ample working space and safety for men whose duties require them to work on the pole line can be made by the method shown in the illustration, which is in use on the Denver Gas & Electric Company's distribution system in Denver. In the illustration a right-angle corner is shown. The strains are taken by guys run back to a guy pole. On the upper arm the method of taking the strains is clearly shown. A suspension-insulator unit is used as an insulator between the guy and the line conductor. The corner poles may be set in the parking space between the sidewalk and the curb where the space is wide enough, or the poles may straddle the sidewalk on narrow streets. The corner is also used a great deal in connection with bridge construction for alley distribution lines. It avoids the usual complication




CORNER CONSTRUCTION FOR HEAVY WORK

encountered where double buck-armed poles are used in combination with clamps and arm guys to carry heavy corners and affords ample working space.

Chicago, Ill. FIELD EDITOR ELECTRICAL WORLD.

## Output of Twenty-seven Major Companies in Central States in 1920

THERE are a number of generating and distributing companies in the Central States which reported an output of 100,000,000 kw.-hr. in 1920 for the first time. The ELECTRICAL WORLD tabulation of all electric light and power companies with an output in 1920 over 100,000,000 kw.-hr., published in the issue of April 23, indicated that there were twenty-one companies of this class in the North Central States and three in the South Central States. Information has lately come to hand indicating that the number of these companies in the North Central States should be increased to twenty-three by the addition of the Northwest Utilities Company, with an output of 113,644,209 kw.-hr., and the Central Illinois Public Service Company, with an output of 106,974,419 kw.-hr. The Louisville Gas & Electric Company reports that its 1920 output was 108,118,350 kw.-hr., increasing the number of companies in the South Central States with an output over 100,000,000 kw.-hr. to four.

## Repairing Mica-Insulated Coils

IT WAS originally the practice whenever a mica-insulated coil was punctured in the plant of the Shawinigan Water & Power Company to replace it with a new coil and send the old coil to the manufacturer for reinsulating, but now such coils are reinsulated in the plant and sometimes without removing entirely from the machine. Taking out a coil is comparatively simple in the case of a bar-wound machine, but with a coil winding the work of raising the overlapping coils, in order to release the lower side of the damaged coil, is considerable, and, moreover, the insulation on the good coils is apt to be cracked in the process. Consequently, when a machine broke down, it was difficult to predict how soon it could be put into service again.

Nearly all the breakdowns that occurred were in the top side of the coil. Some two years ago the practice was begun of cutting off the coil at the back end and replacing the damaged upper half by part of a new coil. The generators on which this was done were 14,000-kva., 6,600-volt, three-phase, 225-r.p.m., one a 60-cycle and the other a 30-cycle machine. They were wave-wound with one-turn coils. This practice was not considered safe by the manufacturer on account of the probable increase in eddy currents in the spliced coil. However, the splice was sectionalized to a certain extent, and these coils have shown no greater tendency to heat than the other coils as far as could be observed. A number of repairs have been made in this way in the last two years, and there has been but one failure of a splice. This was caused by the solder running out of the joint when the winding became very hot because of overload.

Recently a large number of the coils in one of these machines were damaged by a piece of iron being carried in the air gap. The damage in most cases consisted of a cut or nick on the side of the insulating cell next to the air gap. It was decided to repair these coils on the job in order to save time and expense. It was necessary to strip the upper half of the stator in order to restack the iron laminations which had been damaged to a certain extent, but in the lower half the coils were repaired by lifting only the upper half of each damaged coil out of the slot.

The actual repair to a damaged coil consisted first in cutting away the mica cell with a 3-in. taper on each side of the fracture. A longer taper would be better, but was difficult to obtain as the insulation was only 120 mils in thickness. A coating of insulating varnish was then put on the bare part of the coil, and on this two half-lapped layers of mica tape were wound. Each successive layer received a coat of varnish. Since the mica tape was not strong enough to permit drawing up very tight, the third wrapping consisted of cotton tape not lapped. This was followed by four more layers of mica tape half lapped, a second layer of cotton tape, and two layers of 7-mil paper.

A steel clamp was made up to compress the patch to correct size (see Fig. 2). When the clamp was in

place the insulation was baked by passing a heavy current through the coil. This was accomplished by joining the two ends of the coil by a 1,500,000-circ.mil cable on which one or more cable-type series transformers were strung with their secondaries paralleled on a 220-volt, 60-cycle circuit. On each end of the cable was a Dossert lug. The coil ends were clamped between a copper plate and the face of the lug. However, the series transformers available did not give sufficient potential on the short-circuited coil, and a special transformer was built for this purpose. Some 30-mil iron from an old transformer was cut into rectangles, 3 in. x 8 in., and laid up to form a core 18 in. long with an opening 5 in. x 5 in. square. A winding of sixty turns of two No. 10 double-cotton-covered wires in parallel was put on and taped over. The coil stuck through the opening acted as a one-turn secondary winding.

With 440 volts applied to this transformer a circulating current of 2,800 amp. was obtained in a coil removed from the generator. This was more than ample to heat the coil to a baking temperature. Owing to the magnetic losses in the steel clamp it would heat up considerably,

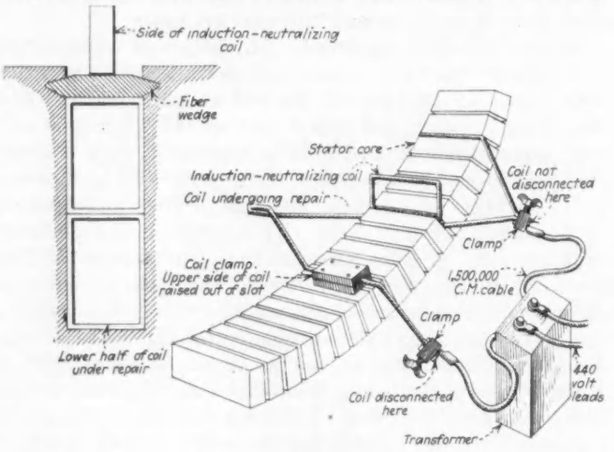



FIG. 1—BAKING A COIL WITHOUT REMOVING FROM GENERATOR

with the result that the patch was subjected to the highest temperature of any part of the coil. From four to five hours was required to bake the patch thoroughly, after which the coil was allowed to cool before the clamp was removed.

As previously stated, a number of the coils were repaired without removing them from the machine by raising the upper half only from the slot. When the heating transformer was applied to these coils a current of only 1,400 amp. was obtained. This reduced current was due to the lower half of the coil being embedded in the slot with a consequent considerable increase in reactance. Since 1,400 amp. did not give sufficient heating effect, an inductance-neutralizing device was made up in the form of a rectangular short-circuited coil of $\frac{1}{4}$-in. x $1\frac{3}{8}$-in. copper bar. This coil was set up as shown in Fig. 1, with one side resting on the wedge in the slot containing the lower half of the coil under repair. The result was to increase the circulating current from 1,400 amp. to 2,000 amp., which was sufficient to bake the insulation. It may be interesting to note that the rectangular coil was held in place so firmly by the magnetic attraction that it required the full strength of a man to pull it away from the slot.

One of the repaired coils successfully withstood a test potential of 22,000 volts applied for several minutes. The coils repaired out of the machine were tested regularly to 14,000 volts, and those repaired in the machine were tested to 10,000 volts. None of the patches broke down, though several of the coils punctured at other places, requiring a second repair. The generator has

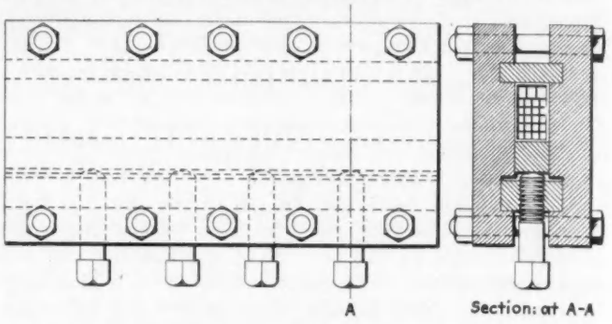



FIG. 2—IRON CLAMP FOR HOLDING MICA INSULATING PATCH ON COIL WHILE BAKING

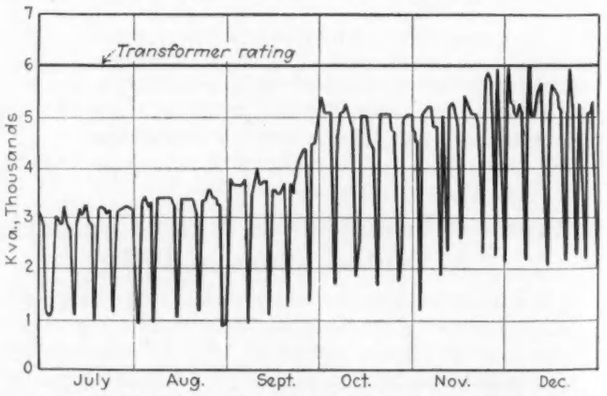
since been in service three months without any indication of breakdown. Later on a coil on the 60-cycle generator broke down on test and was repaired in this manner in considerably less time than was formerly required to insert a new half coil.

C. R. REID,
Power-House Superintendent.
Shawinigan Water & Power Company,
Shawinigan Falls, Quebec.

## Graphic Record Shows When Equipment Is Being Overloaded

IN ORDER to see quickly just what load is being carried by substations of the Worcester (Mass.) Electric Light Company, curves similar to the one in the accompanying diagram are plotted weekly from the daily log sheets. This curve shows the daily peaks on a substation serving an industrial district. It will be noted that the load has increased until some of the daily peaks are higher than the transformer rating of the substation. Should the load continue to increase, more transformer capacity must be placed in the substation. The trend of such a curve from year to year affords valuable indication of future requirements.

This is only one of a number of purposes for which




GRAPHIC RECORDS INDICATE THAT MORE TRANSFORMERS MUST BE INSTALLED IN THIS SUBSTATION IF LOAD GROWS

graphic records are kept by the distribution department of the Worcester Company. Several of these records have already been described in the ELECTRICAL WORLD.

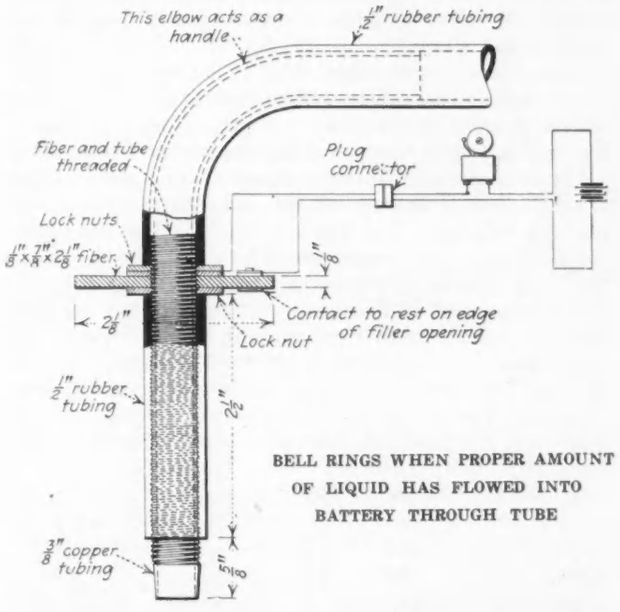
GEORGE M. HARDY,
Superintendent.
Worcester Electric Light Co.
Worcester, Mass.

# Industrial Applications

**The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required**

## Arrangement for Quickly Filling Alkaline Storage Batteries

A BELL rings a signal when a cell has been filled to the proper height by means of the filler made in the vehicle-battery department of the American Railway Express Company, New York City. This prevents the cell from overflowing and allows the work to be done as quickly as possible. Either water or potash solution may be employed with this filler. The liquid to be used is held in a barrel which is supported upon




BELL RINGS WHEN PROPER AMOUNT OF LIQUID HAS FLOWED INTO BATTERY THROUGH TUBE

a movable platform. This platform is a table about 4 ft. high mounted upon a four-wheel hand truck so that it may be moved from one location to another with ease. A faucet is screwed into the threaded opening of the barrel, and to this faucet is attached a rubber tube ½ in. in diameter. On the lower end of the tube the filling device is fastened. This is made by inserting a ⅜-in. copper tube bent as shown in the drawing into the end of the rubber tube. Just below the end of the rubber tube a lamp cord is fastened between two lock-nuts on the copper tube. The lower end of the tube is inserted into a hole in a fiber block, ⅛ in. x ⅞ in. x 2⅛ in. in size, and a lock-nut below holds it firm. Below this a 2½-in. length of ½-in. rubber tube is slipped on to the copper tube, leaving 5/16 in. bare on the lower end. In the end of the fiber block, as shown in the illustration, is set a binding post which extends through the block, forming a contact point below. To this post is attached another lamp cord. The section of the tube above the fiber is then taped up and both lamp cords are taped together to prevent them from being pulled off. To the other ends of these lamp cords a small plug connector is fastened. The receptacle for this is attached to two wires which lead respectively to a small low-voltage battery bell and to a clip which may be attached to a battery terminal post. The other wire from the bell also has a clip which may be attached to a battery terminal post.

In operation these clips are attached across three or four cells convenient to the battery being filled. The faucet is opened, allowing the liquid to flow into the rubber tube after the tube has been pinched shut by the finger. The end of the copper tube is inserted in the vent hole of a cell and the liquid is allowed to flow. When the liquid rises high enough to touch the brass tube, this completes the circuit from the brass tube through the solution in the battery to the metal case of the cell which is touching the contact screw on the fiber block. This causes the bell to ring, which is the signal that the tube should be pinched and the flow of liquid cut off.

The proper height of solution above the plates is about ½ in., and for different types of cells it may be necessary to adjust the length of the tube below the fiber block. Either water or potash solution may be used with this filler as there are no valves or small openings which would be clogged by the potash.

F. A. REIBERT,
Foreman Battery-Repair Department.
American Railway Express Company,
New York, N. Y.

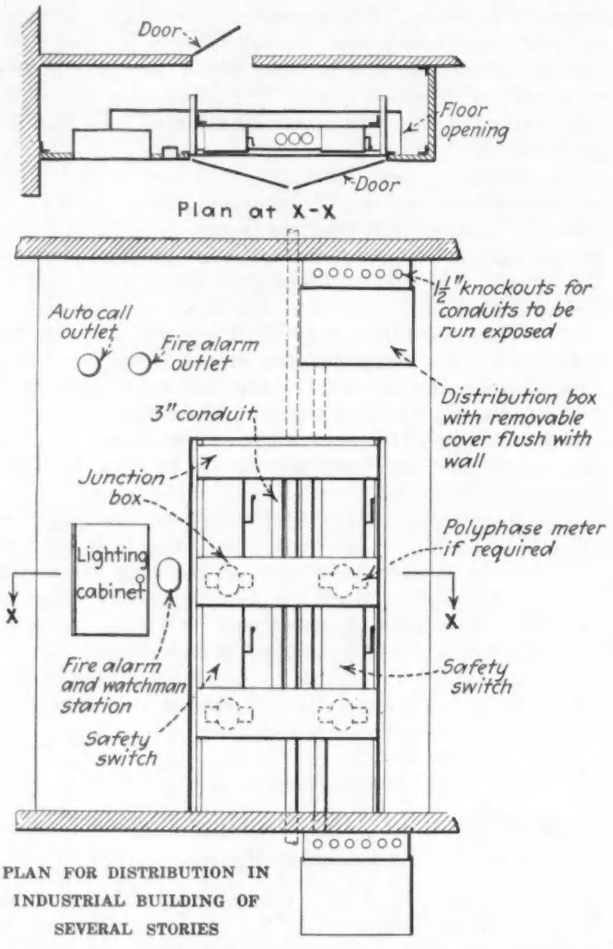
## A Method of Distributing Power for Industrial Plants

FOR industrial plants where power is required throughout buildings of five or more stories distributing power can usually be simplified by the use of feeder "chases." Chases, which are nothing more than vertical runways for cables in conduits, are not new in their application, but the points of interest are the details employed in using the chases as control centers for each floor. In the past it has been customary to use slate panels with fused knife switches to control the various circuits on each floor, with sometimes a main switch for "killing" the whole floor, but today engineers are more inclined toward installing safety switches for performing this function, with the advantage of having a safer and more economical installation.

The accompanying drawing illustrates the general details of this type of construction. In this case there is provision for lighting cabinets, watchman, fire alarm and auto-call stations in the same chase at the side of the power section. The walls are of hard cement plaster on expanded metal supported by a steel framework. This steel framework is worked in with the supporting steel for switches, etc. Metal-clad doors are used, and thus a fireproof compartment is obtained.

For closing the openings in the floors inside the chases to conform to the regulations of the fire underwriters, a wire grill was placed over the holes at each floor and covered with mineral wool. This would prevent flue action in case fire succeeded in entering the chases.

There is a large rectangular steel box installed beneath each two switches and one of smaller dimensions above the top switches. The boxes underneath the switches may be used for the dual purpose of junction box and meter box. It may be necessary to meter each




PLAN FOR DISTRIBUTION IN INDUSTRIAL BUILDING OF SEVERAL STORIES

feeder in order to obtain accurate cost records, and this provides for mounting a polyphase meter in the box with a hole through the cover for reading dials, or the meter may be mounted directly on the cover of the box.

Three 3-in. conduits are run between boxes. The one in the center is to carry the main feeder from which the branch circuits are tapped, there being no main switch on each floor. The conduit on the right is intended to carry the branch feeders after they have left the switch. This conduit is terminated at the ceiling in a large pull box from which conduits are run exposed under the ceiling to the various points of usage. This conduit is also extended to the distribution box on the ceiling below, which facilitates running feeders under the floor and finally bringing them up through the floor at the point of usage. The conduit on the left is a spare to provide for contingencies.

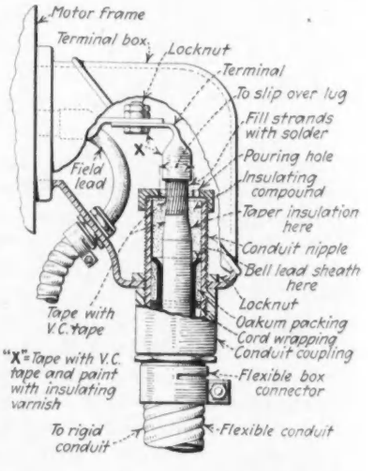
Switches were obtained with boxes deep enough to allow the switch cover to clear the junction boxes. A 5-in. switch box was required, as the junction boxes must be at least 4 in. deep to allow for 3-in. conduits in the side. The switches at the top are of 60-amp. capacity, and the bottom switches are of 100-amp. capacity. All switches are rated at 500 volts, as the system is 440 volts, three-phase, 60 cycles. Switches are installed only as required by the installation of distribution circuits.

Harry M. Hope Engineering Co., Boston, Mass. D. E. HAYNER, Electrical Engineer.

## Sealing Cable in Terminal Box

IN A RECENT design of the electrical power layout of a large industrial plant using a 250-volt direct-current service, the choice of power conductors was limited to paper-insulated, lead-covered cable, because of the moisture present and certain other conditions. It therefore became necessary to seal these cables effectively at both the switchboard and the motor ends. This was accomplished in the former case by the use of standard single-conductor potheads, but as the motors were of large capacity and were relatively close to the floor, space would not permit similar construction at the motor end. Furthermore, the small space between the floor and the motor terminal box was utilized by flexible conduit in order to allow a certain amount of adjustment in the alignment of the motors.

Accordingly some means had to be devised of effectively sealing the cables within the terminal box itself, which resulted in the scheme shown in the accompanying sketch. Only common standard pieces were used in order to eliminate the extra expense which would result from the use of special fittings. The parts were assembled as follows: The flexible conduit, box connector, coupling and nipple were secured in place at the end of the rigid conduit protruding from the floor, and the cable was pulled in from the switchboard end, allowing about 6 in. to extend from the end of the nipple. The cable was then wrapped with cord and packing, the lead cut and partly belled out, and the terminal soldered in place. The whole was then carefully taped from the lead up to the terminal, after which the cable was pulled back into the position shown in the sketch. The lead was then belled out tightly against the nipple with a small stick and the nipple secured into the terminal box by the lock nut. After the fiber cap was screwed in place the nipple was filled with compound. The field conductor was brought into the rear of the terminal box and, being rubber-insulated and lead-covered, did not require sealing at the end. All lead sheath and conduit were effectively grounded at the switchboard with standard ground clamps to a copper ground bus.




END OF LEAD-COVERED CABLE SEALED WITHIN MOTOR TERMINAL BOX

With this arrangement the motor can easily be disconnected, either by removing the fiber cap and lock nut or by unbolting the box from the motor frame.

Boston, Mass. R. L. KIRK.

# How to Measure Average Power Factor with Reactive-Component Meters

FOR the industrial electrical engineer the measurement of average power factor by the reactive component method is of growing importance, first, because there is an increasing tendency to include power-factor clauses in contracts for the sale of energy, based on this method, and, second, because it gives an accurate indication of average working conditions in an industrial plant. Even where energy is generated in the plant, the method is fully as valuable in establishing a method of checking the number of reactive kilovolt-ampere-hours against the kilowatt-hours used.

The method is comparatively simple and standard integrating meters can be used if desired, although apparatus is now available that eliminates the use of constants in arriving at the true value of the reactive hours. Many studies have been made of this method of power-factor measurement, although the two outstanding ones are one by the meter committee of the National Electric Light Association, W. L. Wadsworth chairman, and a paper presented by F. A. Coffin of the Milwaukee Electric Railway & Light Company at a recent convention of the Wisconsin Electrical Association. In this article both of these sources have been drawn from.

In the determination of average power factor by this method it is necessary to take readings with a kilowatt-hour meter and a reactive kilovolt-ampere-hour meter over a period of time for which the average power factor is desired. Where power factor at the time of maximum demand is required, it is necessary, however, to install printing devices of some kind so as periodically to record the meter reading. It is, however, the average power-factor method and the determination of the total reactive kva.-hours that are the purpose of this study.

The formula used in the determination of power factor by this method is as follows:

Power factor equals the cosine of the angle whose tangent equals total reactive kilovolt-ampere-hours divided by total kilowatt-hours or

$$\text{Power factor} = \frac{\text{Total kilowatt-hours}}{\sqrt{(\text{Total kilowatt hours})^2 + (\text{total reactive kva.-hours})^2}}$$

It is possible to reduce this formula by various ways, and in his paper Mr. Coffin has called the kilowatt-hours $A$, as the base of the right-angle triangle, and the reactive kva.-hours $B$, which, of course, is the vertical side of the right-angle triangle. By substitution in the formula and where $C$ equals the hypotenuse of the right-angle triangle or kva.-hours, power factor equals $A$ over $C$, and therefore:

$$\text{Power factor} = \frac{A}{\sqrt{A^2 + B^2}}, \text{ or}$$

$$= \frac{1}{\sqrt{1 + (B/A)^2}}.$$

In both of these formulas the problem is to find the true values of the reactive kva.-hours before the power factor can be determined. In Fig. 1 are shown thirteen

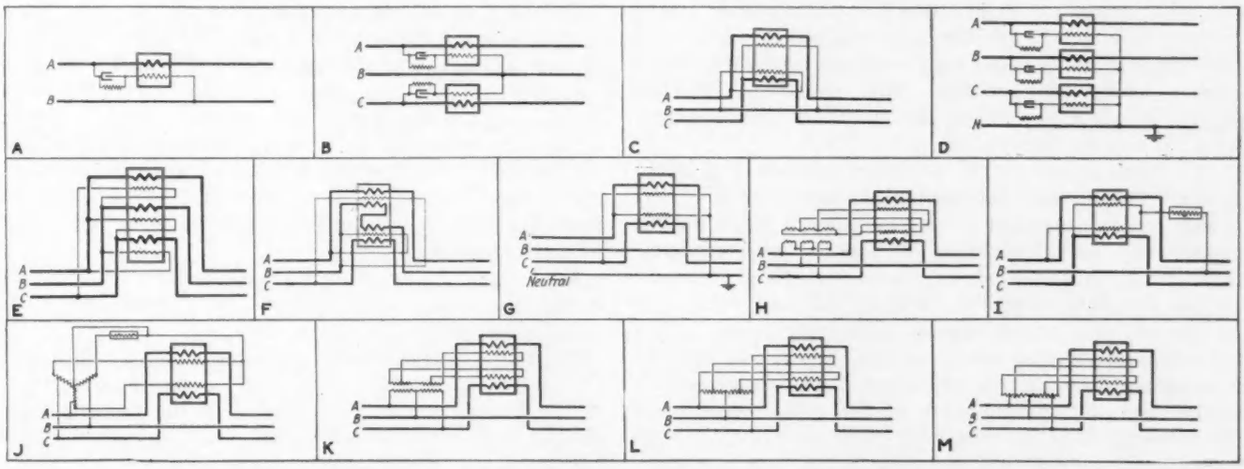



FIG. 1—METHODS OF CONNECTING INTEGRATING METERS FOR DETERMINING THE REACTIVE ENERGY COMPONENT

A—For single-phase measurement it is necessary to employ a special meter with an unlagged potential circuit. This meter has its potential circuit so adjusted as to bring its current in phase with the potential across it instead of 90 deg. out of phase, as in the case of the ordinary watt-hour meter. Standard watt-hour meters may be used for this purpose, provided that suitable means are employed for correcting the phase position of the potential current. A meter in use up to the present time has employed a combination of resistance and condensers for this purpose.

B—Two single-phase meters used on a two-phase circuit in the same general way as in *A*.

C—An ordinary two-element polyphase watt-hour meter with one potential reversed may be used for reactive component metering by connecting a current coil into each phase and impressing the potential of the other phase on the potential circuit.

D—Three single-phase reactive-component meters may be employed for measuring reactive kva. on circuits where a neutral point is available, so that individual phase voltages can be obtained, thus measuring each phase as a single-phase circuit. A three-element polyphase meter may be employed in the same manner.

E—Three-element polyphase watt-hour meter with potential cross-phase. With this connection a constant of 0.577 must be used or this constant must be introduced into the gear train or transformer ratio.

F—Standard four-wire two-element watt-hour meter such as is employed in metering three-phase four-wire circuits. The constant in this case is also 0.577 as in the *E* method, but has the advantage of allowing the use of a standard meter.

G—Two-element meter with a Y potential. The constant in this case is 1.732. Where a neutral is available, connections may be made directly to it, as shown.

H—This method is the same as in G, with the exception that an artificial neutral is established by the use of three potential transformers connected in Y-delta. Under this condition the ratio of transformers may be selected so as to eliminate the use of an odd constant.

I—An artificial neutral may be established by using a special reactor equivalent to the potential circuit of the meter connected from the junction point of two meter potentials to the third deg. For this purpose the potential circuit of another meter of the same type as the one used for measurement may be employed.

J—By the combination of a three-phase auto-transformer and a special reactor circuit the constant of 1.732 may be eliminated and the dial constant be made the same as for a watt-hour meter. In this case the line potential is connected on a tap of the three-phase auto-transformer having a ratio of 0.577 of the entire winding.

K—Two-element meter with open-delta connected potential transformer. This method makes use of a standard two-element polyphase meter and two potential transformers with the middle tap on their secondary winding. The potential coil of each element receives a voltage which is the result of one-half of that which would be impressed upon it if used for watt-hour measurement plus the full voltage for the other element of the watt-hour meter. The potential transformers may be the same as those employed for the watt-hour meters. This method requires that the dial readings be multiplied by a constant of 1.155 if a standard polyphase meter is employed.

L—This method is the same as in K, but is adaptable to low-voltage circuits not requiring potential transformers and makes use of two auto-transformers having center taps. The result is the same as if the middle points of the potential transformers were employed, and a constant of 1.155 is required for the dial reading.

M—A modification of the method shown in L, but so arranged as to give a step up ratio of 1.155 to 1, thus insuring normal voltage upon the meter potential circuit and eliminating the odd register constant.

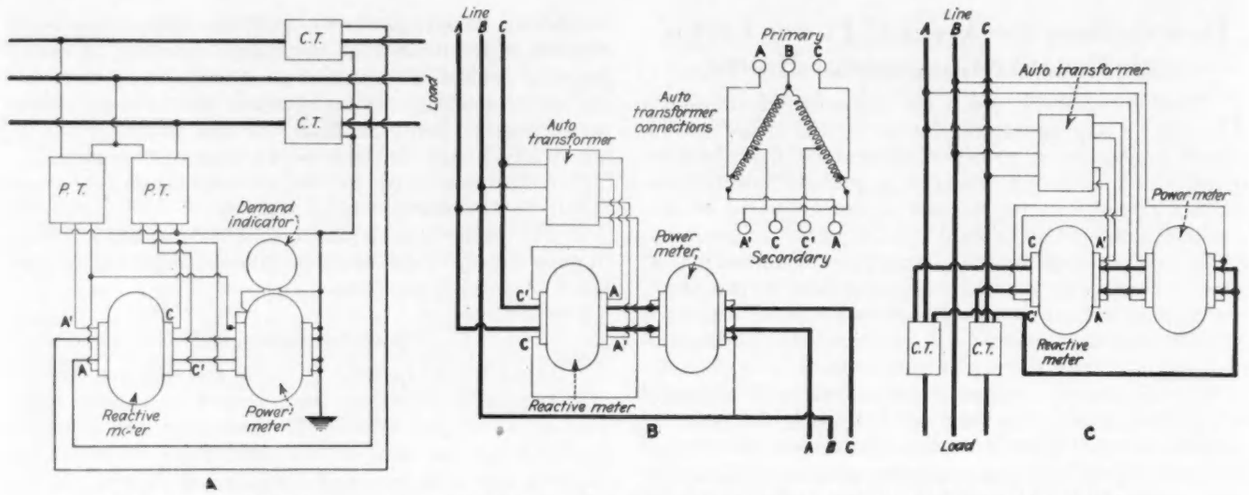



FIG. 2—CONNECTION OF TWO INTEGRATING METERS FOR THE PURPOSE OF MEASURING THE REACTIVE AND ENERGY COMPONENTS

A—While the special voltage is obtained from the mid taps of either potential metering transformers or balancing coils, it is necessary to use a constant of 1.155 in order to get the true reactive hours from the meter registration. In case the reactive meter rotates backward with a lagging load, interchange $C$ with $A'$ and $A$ with $C'$.

B—Where a special auto transformer is used the connections are as shown. If the reactive meter rotates backward with a lagging load, interchange $C$ with $A'$ and $A$ with $C'$.

C—Here the auto-transformer is used as in $B$, but current transformers are also used. In this case if the reactive meter rotates backward with a lagging load, interchange $C$ with $A'$ and $C'$ with $A$.

wiring diagrams for the connection of integrating watt-meters for the purpose of measuring the reactive component meters. In any of these methods the principal feature is to get the meters connected so that the potential of the reactive component meter will be 90 deg. from the normal potential. In a two-phase system where there already exists a potential 90 deg. out of phase with the current this method can be easily applied in practice by using the potential from phase $A$ with the current from phase $B$ and the potential from phase $B$ with the current from phase $A$.

In a three-phase circuit, however, a different problem exists. There being no voltage at right angles to the current, it is necessary to develop such a voltage by a combination of the existing voltages. The equipment required in this method, as previously stated, consists of two standard watt-hour meters, one of which may be the regular power service watt-hour meter. The current coils of the second meter, which is used for measuring the reactive component, are connected in series with the current coils of the power meter, but the potential coils are connected from some one phase to a point midway between the other two phases. In other words, if a voltage triangle is drawn, this voltage would be represented by a point midway on the side of the triangle.

In the case of primary service installations metering is done on the primary side of the service transformers and potential metering transformers are used. Mid taps are usually found on the secondaries of these transformers, and the desired voltage connections can be obtained without the use of additional equipment.

In the case of secondary service installations, however, where the metering is done on the low-voltage side of the service transformers and potential metering transformers are not used, it is necessary to use a special auto-transformer, or possibly two ordinary three-wire balancing coils, to get the necessary voltage connections. Fig 2 shows a diagram of typical metering connections where the special voltage is obtained from the mid taps of either potential metering transformers or balancing coils.

With connections made in this manner it must be remembered that the voltage impressed upon the reactive component meter is only 86.6 per cent of the voltage on the power meter, and consequently the registration of the reactive meter will be only 86.6 per cent of the actual reactive component, or the reactive component will be 1.155 times the reactive meter registration $B$, and the equation will become:

$$\text{Power factor} = \frac{1}{\sqrt{1 + (1.155\ B/A)^2}}$$

In Fig. 3 a curve has been plotted by Mr. Coffin from which it is possible to arrive at the power factor by using the direct ratio of $B/A$. It is also possible, if desired, to calibrate the reactive component meter by adjusting the disk constant so that the registration will be the correct reactive component.

Manufacturers of metering equipment have developed a special auto-transformer for use in this form of metering which is relatively inexpensive and has the proper voltage taps to give correct registrations on the reactive component meter and require no correction in equation. Figs. 2B and 2C show diagrams of the connections of this transformer and typical metering connections where it is used. It may be considered a regular accessory to the reactive-component meter and used even where potential metering transformers are in service.

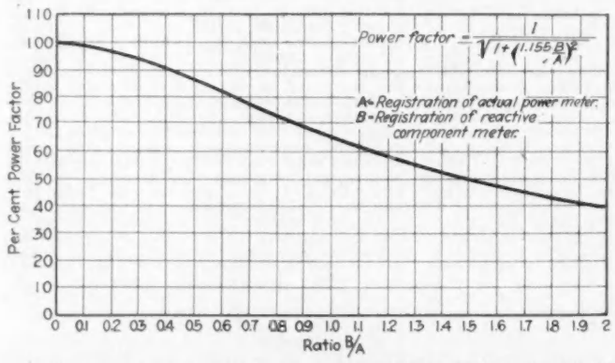


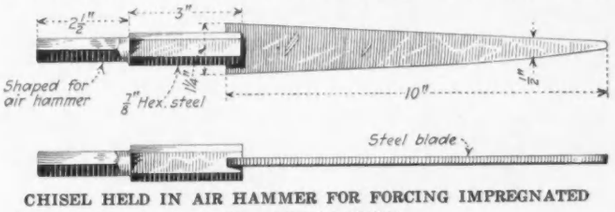

FIG. 3—POWER FACTOR MAY BE READ DIRECTLY WHEN THE RATIO $B/A$ IS OBTAINED BY THE METHOD OF FIG. 2A

## Air Hammer Forces Impregnated Coils from Slots

A QUICK method of removing impregnated coils from motors developed in an Eastern shop makes use of an air hammer which forces a steel chisel under the coils. The chisel should be almost as wide as the slot, shaped long and tapered somewhat as shown in the accompanying drawing. The large end is formed to fit in the air hammer. This air hammer is size No. 1, ⅞ in. x 3 in. Before the chisel is applied the wedges are first driven out with wedge drifts. In operation the small end of the tool is inserted under the coil at the end of the slot nearest the commutator and the air is turned on the hammer. The tool is then moved into the slot, forcing out the coil.

When removing coils from a closed or partly closed slot the ends of the coils at one end of the machine are first cut off flush with the laminations by means of a cold chisel with a flat, wide blade. Then the coils are pulled out at the other end by means of an iron bar. One end of the bar rests on a wood block placed on the end laminations to prevent damage by the bar. By prying up on the point of the coils they are pulled through the slots. Several coils may sometimes be pulled at once.

After the coils are removed a portion of the slot-cell insulation has a tendency to stick to the iron. This is removed very quickly by the application of a gas




CHISEL HELD IN AIR HAMMER FOR FORCING IMPREGNATED COILS OUT OF SLOTS

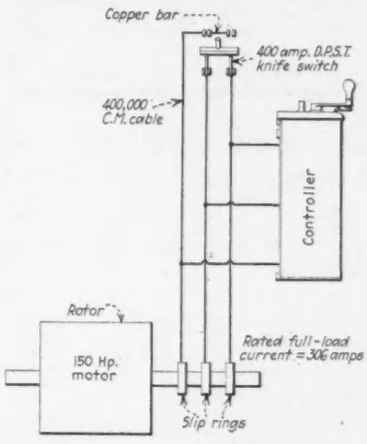
flame mixed with a slight air pressure directed into the slot, care being taken not to overheat the iron by holding the flame too long in one spot. This method has been found to be a great improvement over the old way, that of scraping, as it saves time besides leaving a smooth surface in the slots for the new cell insulation. After this operation the laminations must be examined and any sharp points must be filed off.

East Orange, N. J. E. R. DEBMAN.

## Additional Switch Saves Contacts of Starting Controller

TO PREVENT burning of the "running" contacts of starting controllers which were evidently overloaded, a short-circuiting switch was employed by the writer with good results. The controllers were connected on the three-phase secondary side of two 150-hp. slip-ring induction motors. Owing to war conditions, the plant was forced to accept starting controllers of obscure manufacture, as none of the first-class companies could make delivery. Apparently these controllers were badly overrated, because after a few weeks of service both of them caused trouble by burning the running contacts so severely that the motors had to be shut down until the contacts could be replaced. This continued to happen at intervals of only two or three weeks until the knife switches were installed, as shown in the accompanying sketch. These two-pole, single-throw switches relieved the controller contacts of a great deal of the current and entirely eliminated the trouble, the present contacts having been in service more than three years.

The motor is started with the controller, as usual, and after the controller handle reaches the final position the switch is closed, providing a short circuit of low resistance in parallel with the controller. Incidentally, this gives the motor slightly better operating characteristics by reducing the resistance of the secondary circuit. It is of course understood that this expedient adds one more switch to be opened before the motor is started again. In stopping the motor it should always be slowed down by the starting controller before the line switch is opened. Before this can be done the short-circuiting switch must be opened, and therefore it adds no danger to the installation. It is, however, sometimes the practice to stop the motor by opening the line switch first, and sometimes this switch is opened by overload relays. The operator must then bring the controller to starting position before he throws in the line switch. In such a case there is a chance that he may forget to open the short circuiting switch. Such neglect will allow line voltage to be thrown on the motor while its secondary is short-circuited, which may cause serious damage.

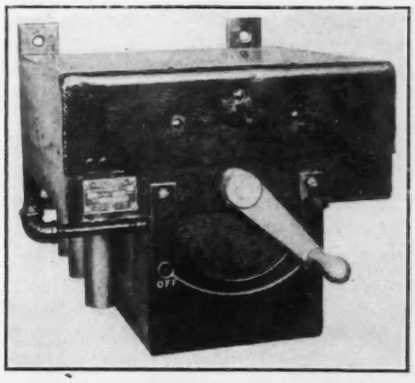



BURNING OF RUNNING CONTACTS PREVENTED BY SHUNTING WITH KNIFE SWITCH

Empire Tire & Rubber Corp., Trenton, N. J. M. J. RICH, Experimental Engineer.

## Inclosed Fused 2,500-Volt Switch

AN INCLOSED fused 2,500-volt entrance switch has been developed recently for application on high-voltage distribution where safety features are desired. This switch is rated at 100 amp. and 2,500 volts and is made with two and three poles, single-throw. These switches are principally for use by distributing companies at the end of 2,500-volt distributing lines and at the entrance of the line to the customer's plant. All live parts are completely inclosed in a pressed-steel case and tank. The leads enter through fiber bushings, and the cover cannot be opened when the switch is closed.




2,500-VOLT SWITCH COMPLETELY INCLOSED —STANDARD FUSES MOUNTED INSIDE

# Central Station Service

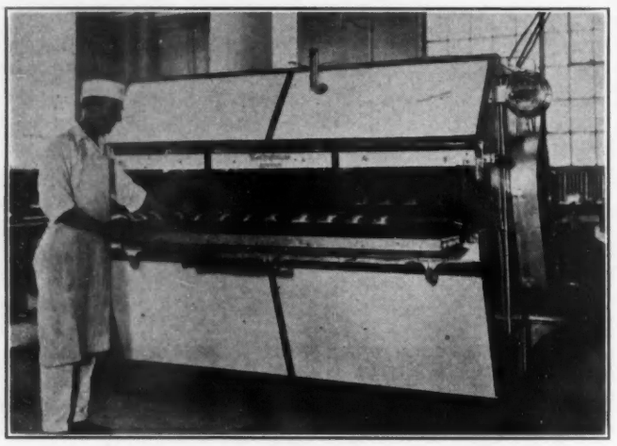
A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

## Commercial Baking by Wire

By John M. Strait

ONE of the comparatively new fields for increasing the central-station company's revenue is commercial heating, and the electric bake oven offers a steady, profitable load which comes for the most part at off-peak hours. The development of electric baking has reached a stage where absolute certainty as to the uniformity and quality of the baked product is assured, and it is being applied to many commercial bakeries with complete success. Uniformity of product, automatic temperature control, flexibility, economy and ease of operation are among the outstanding features of a recent type of electric oven shown here.

The oven is equipped with six standard oven heaters, each rated at 3.5 kw. at 220 volts, giving a maximum



FRONT VIEW OF ELECTRIC BAKE OVEN

capacity of 21 kw. These heaters may be operated continuously day after day without danger. The oven has a capacity of 112 1-lb. loaves, or 96 1½-lb. loaves, or 56 pies, and is capable of turning out 200 or 160 loaves and 100 pies respectively per hour.

There is a distinct saving in labor and time which is effected primarily by the ease and simplicity of control and operation of the oven. Owing to the fact that after the thermostat has once been set at a given value it requires no further attention, a baker can turn out considerably more bread, pies and cakes than with any other type of oven, and he has the further assurance of an absolutely uniform product. The operation is simplicity itself. If an operating temperature of 450 deg. Fahr is desired, the thermostat is set at 450 deg. The "on" button is then pushed, turning on the current, and the oven is allowed to attain the baking temperature, after which the automatic control automatically maintains the baking temperature. The raw products are then placed in the oven to its capacity and the motor drive started to operate at its rated speed of one revolution per minute. No further attention is required until the expiration of the baking period as given in the instructions. Baking temperature will be attained in one hour.

The superiority of bread, pies, cakes and pastries baked by electric heat over those baked in a coal, gas or oil-fired oven will convince even the most skeptical baker that the electric oven produces ideal results.

## Commonwealth Edison's Method of Compensating Salesmen

THE Commonwealth Edison Company of Chicago has a very complete, carefully worked-out system of compensation of salesmen on either a split salary and commission basis or a straight commission basis. The system has been in practical operation for some time and was designed with the following objects in view: (1) To obtain business, especially of the classes known to be profitable; (2) to hold present customers, keep them satisfied and encourage them in the larger use of electricity; (3) to develop new avenues for the use of electricity and to educate the public to its wide use; (4) to put a premium on constructive business getting as against mere order taking; (5) to follow up business secured and have it connected without delay.

The schedule provides for the payment of commissions to lighting, power, heating, house-wiring, store-lighting, industrial-lighting and appliance salesmen. It provides that the total amount of commission paid to any one salesman shall not exceed $2,000 per year, and that salesmen working on a straight commission only shall be unlimited as to the amount each can earn in any one year.

The rules and regulations covering the payment of commissions on classified business are compiled with the sole purpose of paying commissions in accordance with the value of the respective classes of business to the company.

The schedule also provides for the payment of commissions based on horsepower, on 50-watt equivalents, on number of sockets, on number of receptacles, on specified units, 100-watt, 200-watt, etc., or on respective appliances, all in accordance with the classification of the various kinds of business and also the value of the sale to the company. It also provides for the payment of a smaller commission on "successor" contracts limited to one within a definite period.

It is interesting to note that in the case of house-wiring contracts a larger commission is paid on all floor or chair rail receptacles than on lighting outlets when they are in addition to the regular lighting outlets in the same room.

Ninety per cent of the commission is paid to the salesman and 10 per cent to the supervisor in charge. The schedule further provides for the imposing of penalties for discontinued business upon which commissions have been paid.

# Apportioning Power Costs Among Various Classes of Consumers

By G. E. Quinan
Chief Engineer Puget Sound Traction, Light & Power Company

SO MUCH has been said on the subject of service cost that it will perhaps be well to dispel at the outset any apprehension there may be that a complete solution of the whole matter is about to be offered. The writer might have undertaken such a commission twenty years ago, and with a light heart, but at the present time will content himself with offering a method for apportioning against the various classes of service those costs which result from the common use of facilities by two or more classes but which cannot be easily and directly traced to any one class. These have been called fixed costs, but they are not fixed costs in the strict accounting sense, as the following tabulation will show:

### Costs to Be Apportioned

A. Investment (annual charges). (Does not include investment made or reserved exclusively for the class under consideration.)

B. Operation and maintenance of above. (Does not include fuel, feed water or other items that vary with use.)

C. Proportion of general expense.

### Costs Directly Assignable

A. Investment (annual charges). Includes all investment made or reserved exclusively for the class under consideration, embracing such items as meters, services, service transformers, distribution lines, etc.

B. Operating cost. Includes operation and maintenance of above. Includes also items which can be readily traced to the class or individual, such as fuel, feed water, utilization expenses, bookkeeping, billing, etc.

C. Proportion of general expense.

The above classifications are not intended as categories to be invariably followed, but are merely illustrative of the character of costs which in the one case must be apportioned and in the other may be directly assigned, partly on the basis of kilowatt-hours used and partly on basis of number of customers. General expense as carried on the utilities' books should be distributed as far as possible to the various operating accounts. The remainder may then very reasonably be split between the two above classifications in the proportion of the totals of all other costs.

This discussion will be confined to the first of the two general classes of costs, which for want of a better term will be called "fixed costs."

### Cost Responsibility

Common fixed costs are by this method apportioned on the basis of the "cost responsibility" of each class of service, which is considered to arise out of the *use made*, and is completely determined when the relation of this use to the total use is known. It is not influenced in any way by the value of the service or kindred considerations which find their proper place not in costs but in rates.

The apportionment of cost against any class, depending as it does both on the use of the particular class and on the combined use of all other classes, will be called the "relative cost." This expression is appropriate also in that an apportioned cost attaches to a particular class not in an absolute sense but as its relative portion of a common burden.

Now we have a faithful picture of the use which each class makes of the company's facilities in its characteristics load curve, and we have in the system load curve a picture of the combined use of all classes. The part played by any one class in helping to produce the composite picture will now be analyzed.

As is well known, the combined demands of customers vary at different times of the day and year. Because of their habits and necessities they require, collectively, a much greater investment to serve them at 5 p.m. than at 3 a.m., a greater investment at 10 a.m. than at 10 p.m. Referring to accompanying chart, it is seen that the combined demands of all consumers around 4 p.m. require the installation of 5,000 kw. of capacity which is used less than two hours per day; to meet the demands at 10 o'clock in the morning requires 5,000 kw., which is used less than seven hours per day, while the total capacity of 30,000 kw. required at 3 o'clock a.m. has not an idle minute throughout the twenty-four hours.

We can, in fact, readily think of facilities as consisting of a number of individual plants, of equal capacity (for simplicity), operating for various durations each day.

In the chart below it is assumed that there are sixteen plants, of 5,000 kw. each, to carry the maximum point of the system load curve *A*. All but five of these are idle part of the day, the idle hours for each

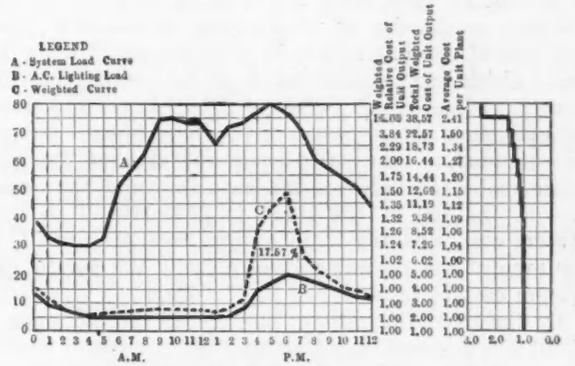



CHART FOR PRORATING POWER COSTS AMONG DIFFERENT CLASSES OF CONSUMERS

plant increasing progressively from the bottom to the top of the chart. The output of each of these partly idle plants is less than that of the first five, and the cost per unit is therefore greater.

The cost of one hour's use of each of the first five plants is evidently one-twenty-fourth of the day's fixed costs on each plant; the cost of one hour's use of a plant which operates only twelve hours a day is evidently twice as great, or one-twelfth of the day's fixed costs on that plant.

On the chart the cost of unit output of a continuously operating plant has been taken as unity, and the weights in the first column indicate the relative costs of unit outputs of each of the sixteen plants. It will be seen that the fourth plant from the top operates twelve hours a day and so has the weight 2, and the uppermost plant operates only one and one-half hours a day and has the weight 16.

Now, consider the system load curve during the hour from 9 a.m. to 10 a.m. Customers using power at that time require, collectively, fifteen of the sixteen plants to serve them, with weights ranging from 1 to 3.84. The total cost of serving them for this one hour is equal to the sum of the weights or 22.57 (see second column

2), while the average per plant for this hour is 22.57 divided by 15, or 1.5 (times the cost of one hour's use of a continuously operating plant, which we assume to be unity).

This figure 1.5 (see column 3) is the weight applying to the hour between 9 a.m. and 10 a.m. and to all other hours of the day when the system load curve lies between 70,000 kw. and 75,000 kw. Weights for each hour of the day, obtained in the same way, are given in column 3. To find the weight for any hour, as 6 a.m. to 7 a.m., note the value of the system load curve at that time. It lies between 50,000 kw. and 55,000 kw. and, following horizontally to the right, we find in column 3 the weight 1.15. This weight it will be seen applies also to the hour from 10 a.m. to 11 p.m. The weights in column 3 are plotted in the broken-line curve at the extreme right of the chart. They could obviously be plotted as a continuous curve under the system load curve.

### Relative Cost for Given Class of Service

Having established a means for consistently relating costs at all hours of the day, we are now in position to ascertain the "relative cost" for a given class of customers. Curve *B* on the chart is the load curve of such a class. The area under curve *B* is proportional to the kilowatt-hours used by this class, and if the fixed cost of producing them were the same at all times of day, the area would also be proportional to the cost. Since the cost of serving varies, it is necessary to allow for this, which can readily be done by multiplying the hourly ordinates of curve *B* by the corresponding weights, thus obtaining curve *C*, whose area is directly proportional to cost. Obviously the area of the rectangle embraced between the base line and the dotted line at the top of the chart is proportional to total system cost, and the ratio of the area of curve *C* to the area of the rectangle gives directly the part of the system cost to be assigned to this class.

On the chart the ratio of curve *C* to the rectangle is about 17½ per cent, meaning that the *B* class of service has a relative cost equal to 17½ per cent of the system fixed costs. It is interesting to note that the maximum demand of the *B* curve is 25 per cent of the system demand and the demand at the time of system peak is 22½ per cent of the latter.

Having the relative cost for the class, this can be translated into cents per kilowatt-hour, or dollars per kilowatt per year.

### Composite Curve of Seasonal Variations in Customer's Load

The above illustration has for convenience been based on the daily load curve. In order to obtain closely accurate results, the seasonal variations in load must be considered, which can be done with sufficient accuracy as follows:

For a class whose annual load parallels closely the system load curve it will be sufficient if a characteristic daily load curve taken at the peak-load season of the year is used together with the corresponding system curve. For other classes a composite daily load curve can be obtained for the class and for the system by taking a characteristic day for each of the four seasons of the year, and the analysis then can be carried through.

It will also be readily appreciated that on a large system it may be necessary to introduce several steps into the analysis. To illustrate this we will refer again to the chart. While it is clear that curve *B* must bear 17½ per cent of the generating cost, the percentage for transmission and substation cost will possibly be different. It can easily be obtained by using, instead of the system curve, the load curve of the line and substation of which curve *B* constitutes a part. This can be further extended to the distribution system when accuracy requires it.

### Method Enables Segregation of Individual Class of Business

By means of the method described the relative cost can be obtained for any class or sub-class whose load curve can be drawn, and can even be found for the individual consumer whose load is of appreciable magnitude with respect to the system load. Further, it is evident that the method of apportionment is not concerned with the magnitude of total cost, but is applicable for the apportionment of any sum of money which it may be desired to set against a major division of the business as the cost to be collected in that division.

For instance, in case the public service commission has jurisdiction over lighting rates but not over power rates, it may be necessary to make a division of total cost between these two classes on some basis arising out of the regulatory situation. Having made the division, the apportionment within each class can be consistently carried through by the method here described. Or, if it is desired to consider that all costs are occasioned during sixteen hours of the day, the total cost can be apportioned on the basis of this part of the load curve with entire consistency.

The foregoing scheme of apportionment has been used by the writer in the Puget Sound district for several years past with generally satisfactory results. Cost schedules were prepared for different classes of power consumers with special attention to the hours of the day when power was used, and these have been used as a basis for comparing estimated revenue with the cost of prospective new business, and for reference in the preparation of rate schedules.

## Boston Edison Curtails List of Free Renewal Lamps

EFFECTIVE June 1, the Edison Electric Illuminating Company of Boston announced a curtailment in the list of free-renewal lamps furnished customers in exchange for used lamps. Owing to the discontinuance by the manufacturers of the 100-watt vacuum lamp "B" class, it will become necessary to discontinue the supply of these to customers at an early date. The only vacuum lamp now renewed free is the 50-watt "Mazda" type in pear-shaped bulb, either plain or bowl-frosted, whereas in the former schedule the 50, 100, 150 and 250-watt "B" lamps were renewed free. The 75-watt gas-filled or type "C" lamp in a pear-shaped plain bulb is now listed by the company for the first time and exchanged at 30 cents, the 100-watt "C" lamp being exchanged at 40 cents. The company is calling its customers' attention to the 75-watt and 100-watt "C" lamps as logical substitutes for the 100-watt "B" lamp to be discontinued, and it points out that the increased efficiency of the "C" lamps is considered ample justification for the retirement of the "B" lamps in duplicate sizes.

# Digest of Electrical Literature

**Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World**

## Generators, Motors and Transformers

*Steel Works Motors.*—W. W. WOOD.—Where three-phase current is generated and used for the main motors, the writer says, the modern three-phase live-roll motor can be used without the expense and losses of conversion necessary for direct-current machines and can be relied on to give as good service and greater reliability than a direct-current motor. No hard and fast rule can be laid down, however, as each case must be considered on its merits.—*Beama* (British Electrical and Allied Manufacturers' Association), May, 1921.

*Some Recent Developments in Large Steam-Turbine Practice.*—K. BAUMANN.—An abstract of an important contribution to the subject of development of large steam-turbine units of various types and makes. It is said that the chief factors governing turbine design are (1) reliability, (2) working conditions, (3) thermodynamic efficiency, and (4) over-all dimensions, weights and costs. These items are discussed in detail. An interesting cost analysis is given for a power station of a total installed capacity of 100,000 kw. and steam consumption of 10 lb. per kilowatt-hour, as follows:

TYPICAL BRITISH STEAM-ELECTRIC STATION COST

| | Total Cost | Ratio of Total | Cost per Kw. |
|---|---|---|---|
| 1. Land, buildings and foundation, roads and railway sidings | £850,000 | 0.303 | £8.50 |
| 2. Boiler-house plant | 480,000 | 0.171 | 4.08 |
| 3. Coal-conveying plant | 140,000 | 0.050 | 1.40 |
| 4. Turbine | 250,000 | 0.089 | 2.50 |
| 5. Condensing plant, house set and auxiliaries | 220,000 | 0.078 | 2.20 |
| 6. River work, water culverts | 150,000 | 0.054 | 1.50 |
| 7. Alternator | 220,000 | 0.078 | 2.20 |
| 8. Transformers | 100,000 | 0.035 | 1.00 |
| 9. Switchgear and instruments | 200,000 | 0.071 | 2.00 |
| 10. Converting plant, wiring, cranes, miscellaneous | 200,000 | 0.071 | 2.00 |
| Total | £2,810,000 | 1.000 | £28.10 |

Item 1 may be subdivided into: (*a*) For boiler plant, £3.5 per kilowatt capacity; (*b*) for condensing plant £1.5 per kilowatt capacity; (*c*) for electrical plant and turbine £3.5 per kilowatt capacity.

| | Per Kw. |
|---|---|
| A. Cost of plant which depends on the kilowatt capacity of the station (1*c*) + (7) + (8) + (9) + (10) | £10.7 |
| B. Cost of plant which depends on the steaming capacity of the station (1*a*) + (2) + (3) | 9.7 |
| C. Cost of condensing plant which depends on the steaming capacity and on the thermodynamic efficiency of the turbine (1*b*) + (5) + (6) | 5.2 |
| D. Cost of turbine | 2.5 |
| Total | £28.1 |

The original paper contains a tabular résumé of turbine troubles from 1917 to 1920, with reference to the source of information in each case.—London *Electrician*, April 15, 1921.

*Regulation of Synchronous Generators.*—A. G. WARREN.—An analysis of some of the methods of predetermining regulation of synchronous generators of large size. In this issue the synchronous impedance and magnetomotive-force methods are discussed, other methods being reserved for succeeding numbers.—London *Electrician*, May 13, 1921.

*The Importance of Efficiency in Electrical Machinery.*—MILES WALKER.—A discussion of the problem of the saving effected by the use of more efficient machinery in comparison to the greater fixed charges due to higher first cost.—London *Electrician*, May 20, 1921.

## Lamps and Lighting

*Safety Features of Industrial Lighting.*—SAMUEL G. HIBBEN.—The possibility of increasing production speed and the elimination of dangers to employees are the chief factors dealt with in this article. Results of unshielded lamps on eyesight are also considered.—*Electrical Review*, May 14, 1921.

## Generation, Transmission and Distribution

*Transmission System of the West Penn Power Company.*—GEORGE S. HUMPHREY.—A discussion of transmission-line construction and operating problems in connection with this system.—*Electric Journal*, May, 1921.

*On a Theory of Fluid Friction and Its Application to Hydraulics.*—E. PARRY.—The paper calls attention to a modern theory of fluid friction which is more comprehensive than the older theory and is said to be so adequate for its purpose as to obviate any recourse to the empirical analysis which has so far dominated the subject. The theory as set forth is partly mathematical.—*English Electric Journal*, Vol. I, No. 4, page 146.

*Standardization of High Voltage in Switzerland—I.*—WYSSLING.—Low-voltage standards having been established, the Swiss government is now trying to determine certain normal high tensions for its power stations. Preliminary, 50-cycle, three-phase lines are considered. Single-phase railway systems with 15 cycles to 16⅔ cycles and high-voltage direct-current lines are for the present excluded from this standardization. After due consideration of the results of a vast amount of statistical work, the authorities concluded that there should be two main groups of voltages, *i.e.*, medium tension and highest tension. The lower limit of the first group should be not less than 2,000 volts, preferably higher, the upper limit not more than 16,000 volts. The latter value is to be such as to permit its direct generation by alternators and its direct use in large motors. Statistics showed that 8,000 volts is at present most used for this group, with 6,000 volts and 10,000 volts coming next. In the second group the voltage in the overwhelming majority of cases is 42,000. The question was brought up of what relation, if any, there should be between adjacent voltages, if more than one were used in each group. The logical assumption was the ratio of one to the square root of three, but much thought has been given to Rüdenberg's suggestion of one to the fourth root of ten. The association of Swiss manufacturers has finally submitted two alternatives: (1) 3,300-6,000-10,000-18,000-33,000-60,000-100,000-180,000 volts and (2) 4,800-8,500-15,000-27,000-48,000-85,000-150,000-270,000 volts. Preference is given to the first of these alternatives, with the further suggestion to interpolate a voltage of 8,000. One of the main reasons for this preference is that these

figures conform to most of the foreign voltages. But the Swiss National Federation prefers the second series both for medium and high values. Six main questions have finally been formulated in reference to the two series of voltages, and these have been sent out to all Swiss power plants, manufacturers and public service companies for further comment and discussion. The outcome of this questionnaire will decide the final adoption of standard voltages.—*Bulletin of Swiss Electrotechnical Society*, Vol. IV, No. 12.

*The Modern Steam Condenser.*—E. R. BRIGGS.—Tendencies in the design of modern steam condensers of large capacity are dealt with.—*English Electric Journal*, April, 1921.

*Water Power Developments.*—DANIEL W. MEAD.—A discussion of the question of the amount of total developed and undeveloped horsepower of water-power developments in the country.—*Electric Journal*, May, 1921.

*Boiler Tests with Pulverized Illinois Coal.*—HENRY KREISINGER and JOHN BLIZARD.—The authors present a summary of the results obtained in an extended series of tests of a 468-hp. water-tube boiler fired with pulverized Illinois coal. The results show that, contrary to the customary specification, it is not necessary to pulverize the coal to the extreme fineness of 85 per cent through a 200-mesh screen in order to get good combustion and good efficiency. This ability to burn coarser coal means increased capacity of the pulverizing mills and decreased cost of coal preparation. The results also show that it is not necessary to dry coal to about 1 per cent moisture in order to burn it successfully in pulverized form, and it is stated that with most Eastern coals drying is not at all necessary. Good results can be obtained when the coal is burned at rates varying from 0.5 lb. to 2 lb. per cu.ft. (8 kg. to 32 kg. per cu.m.) of combustion space per hour, and the best results at a rate of 1 lb. to 1.5 lb.—*Mechanical Engineering*, May, 1921.

*Progress in Transmission at 220,000 Volts.*—JOHN A. KOONTZ.—The writer deals particularly with research work in insulation for extra-high-voltage lines.—*Journal of Electricity and Western Industry*, May 15, 1921.

*Observation of Temperatures in Power Stations.*—G. KLEINATH.—Although it is essential for the most economic and safe operation of power stations to be able to know constantly the exact temperature of such vital elements as boiler fires, steam, feed water, generators, bearings, transformers, switches, etc., only a very sporadic use of proper instruments is being found even in modern European power plants. Mercury thermometers, while useful up to about 500 deg. C., are not reliable, because they will frequently give errors as high as 30 deg. Thermometers of the resistance type and thermocouples are most reliable. The former may be used up to 800 deg. C., the latter up to 1,600 deg. C. Higher temperatures may be measured accurately only with optical pyrometers. Full value of the temperature control can be achieved only with self-registering instruments. The author gives a detailed description of a great variety of methods and instruments and mentions the fact that temperature control of electric machines is being used extensively in American plants.—*Elektrotechnische Zeitschrift*, May 5, 1921.

*Transmission of Electric Waves Along Wires.*—A. G. WARREN.—The first part of the paper embodies a determination, using elementary mathematics only, of the fundamental equations of a long transmission line. The interpretation of the equations is also discussed.—*Journal of Institution of Electrical Engineers*, Vol. 59, page 330.

*Recent Improvements in Steam-Turbine Design.*—During the past few years manufacturers have had to concentrate on the construction of accepted designs rather than experiment with new ideas, but since factories have returned to peaceful production a number of new inventions have been put into practical use. It is proposed to discuss these improvements in this and succeeding articles of the series. In this article a type of unit specially designed for shipboard use is described.—London *Engineer*, May 6, 1921.

## Traction

*Motion Phenomena on Catenary Suspension Systems for Electric Railways.*—E. ZEULMANN.—For the safe collection of current from overhead lines it is of greatest importance to maintain as perfectly as possible the horizontal location of the trolley wires. During the past twenty years a great many systems of catenary suspension have been developed with more or less successful take-up devices for any slack of the wire. The author compares the main groups of these systems and arrives at the conclusion that an arrangement with free side-swinging supports and both messenger and conductor take-up gives best results. He asserts that only this system permits of the use of different metals for messenger and conductor—for example, aluminum cables as messenger and a steel wire as conductor.—*Elektrische Kraftbeitriebe und Bahnen*, April 24, 1921.

*Electric Locomotives of the Gotthard Railway.*—W. HEYDEN.—A detailed description of the alternating-current types used on this tunnel line, comprising the 1B + B1 express locomotive (107 metric tons weight, 2,000 hp., built by Brown, Boveri) and the 1C + C1 freight locomotive (128 metric tons weight, 1,700 hp., built by the Oerlikon works). An overhead line operating at 15,000 volts is used.—*Elektrische Kraftbetriebe und Bahnen*, April 10, 1921.

*A Review of Recent Large Electric Locomotives.*—A. LATERNSER.—A comparison between recent American and European locomotives for electric service. Tabular data are given showing the physical characteristics of the various locomotives.—*London Electrician*, May 13, 1921.

## Installations, Systems and Appliances

*Electric Winders.*—J. KIRKWOOD.—Control of winding machinery for electric hoisting is dealt with by the author in this article.—*English Electric Journal*, April, 1921.

*Using Accumulated Heat.*—R. WOLFF.—It is suggested that water can be heated electrically in heat-insulated containers and used in hot-water-heating systems. The heating would take place during the off-peak periods, when advantage could be taken of a low tariff for energy. It is proposed to actuate the heater by an automatic time switch. Two types of heaters are described.—*L'Electricien*, May 1, 1921.

*Relay Protective Features of the Toronto Power Company's Transmission and Distribution System.*—P. ACKERMAN.—A discussion of the problem of protecting the Toronto-Niagara system, giving results with time-limit protection, parallel-feeder protection, double-line protection and the ground selector. The paper concludes with details of design for the various methods of protection

mentioned.—*Journal Engineering Institute of Canada*, Montreal, April, 1921.

*Review of Cost of Rolling Steel in Various Mills.*—G. E. STOLTZ.—The author urges the adoption of electric drive in place of existing steam drive for the main units of rolling mills and presents data to show the saving possible with the electrical system.—Paper presented before the Association of Iron and Steel Electrical Engineers, May, 1921.

*High-Frequency Absorbers.—I.*—G. FACCIOLI and H. G. BRINTON.—This article deals with the effect of resistance in series with a capacitance used as a "high-frequency absorber." It is said that such an absorber is a valuable adjunct to a lightning arrester in protecting against those transient disturbances which are of too low voltage to spark over the arrester but which may still be dangerous because of steep wave front and because under certain conditions they result in the building up of local oscillations.—*General Electric Review*, May, 1921.

## Electrochemistry and Batteries

*Control of Corrosion in Iron and Steel Pipes.*—F. N. SPELLER.—The causes of corrosion, external and internal, in iron and steel pipe mains, with a summary of control methods.—*Journal of Engineering Institute of Canada*, Montreal, April, 1921.

*Study of the Photo-Active Electrolytic Cell, Platinum-Rhodamine-B-Platinum.*—CARLETON C. MURDOCK.—The range of the current-time equations is investigated in this article; also the polarization capacity of the cell and some other cases, as, for instance, there is a flow of current without any light on the electrodes.—*Physical Review*, May 1921.

## Units, Measurements and Instruments

*Measurement of Power at Low Power Factors.*—H. COTTON.—A mathematical treatment of the effect of the lag of current in the potential coil of a wattmeter applied to the measurement of power at low power factor.—London *Electrician*, May 6, 1921.

*Pyrometric Practice.*—PAUL D. FOOTE, C. O. FAIRCHILD and T. R. HARRISON.—A very comprehensive report, of more than 300 pages, profusely illustrated and describing practical methods in use in the industries in the year 1920. The treatise contains nothing of historical development, and purely scientific aspects of pyrometry have been subordinated to practical methods and devices.—*Technologic Paper No. 170, U. S. Bureau of Standards.*

*Testing of Electrical Machinery.*—H. E. MELLOR.—The writer deals with the testing of electrical machinery before acceptance by the purchaser and calls attention to advantages of making these tests in the plant of the manufacturer before shipment.—London *Electrician*, May 20, 1921.

## Telegraphy, Telephony and Signals

*Equivalent Circuit of the Vacuum Tube Modulator.*—JOHN R. CARSON.—The author starts from the consideration of the equivalent circuit to a three-electrode vacuum-tube amplifier. He then derives mathematically the equivalent circuit of a three-electrode vacuum-tube modulator. The resulting theory is applied to a practical example in modulator design and its usefulness demonstrated.—*Proceedings Institute of Radio Engineers*, June, 1921.

*On the Poulsen Arc in Coupled Circuits.*—P. O. PEDERSEN.—A bibliography of oscillating arc investigations with coupled circuits is given. A special form of circuit, wherein the arc and the antenna circuit are coupled electrostatically through an arc "series condenser" and a "shunt condenser," is studied analytically. Experimental results on the same circuit are given, and the practical usefulness of the circuit is discussed.—*Proceedings Institute of Radio Engineers*, June, 1921.

*Tapping of Telephone Circuits During the War.*—A. CARLETTI.—The difficulties commonly met in telephone transmission were utilized by the Italian armies in detecting the plans and movements of the enemy. In a grounded telephone circuit the distribution of the return current through the ground varies with the conditions and formation of the soil, and sometimes it is possible to detect the current flowing through the ground at a considerable distance from the transmitting point. If a metallic conductor connects two grounded points in the zone traversed by the telephone return currents, it is possible to detect these currents by means of a simple receiver at any point along the metallic conductor. At the beginning such detecting stations were placed only in proximity to the enemy lines, but soon the technical staff developed suitable and more sensitive apparatus to be used at any distance. A condenser is used to prevent continuous current from flowing through the receiver and also to reduce to a minimum the impedance of the apparatus, obtaining the conditions of resonance at the average frequency of the telephone currents. In another apparatus a telephone transformer with adjustable ratio was used instead of the condenser. When the ground return system was superseded by the full metallic circuit the solution was given by the poor or defective insulation of the lines. Then the apparatus had to be made more sensitive, amplifiers of different kinds were used, and it was found not only that the leakage current could be utilized but also that the unbalanced conditions of the lines produced an excessive self-inductance and that this phenomenon could be advantageously used to detect messages at considerable distance from the telephone lines.—*Telegraphie Telephoni*, Vol. II, No. 1, page 16.

*Vacuum Tube Amplifiers in Parallel.*—R. V. L. HARTLEY.—The general theory of the power output of a number of dissimilar vacuum tubes operated in parallel is given. The equations obtained are applied to the case where all the tubes have the same amplification constant and also to the case where the tubes all have the same internal resistance. Practical examples are given.—*Proceedings Institute of Radio Engineers*,—June, 1921.

*Automatic Signaling Over Superposed Relayed and Loaded Long-Distance Cables.*—R. T. KING and E. J. BARNES.—In connection with the introduction of long-distance cables the need of providing suitable automatic signaling, giving a service with no delay, has arisen. Experiments have been carried out by the authors, using standard multiplex distributers, to enable each speaking circuit in a group to signal independently over a separate common line.—*Post Office Electrical Engineers' Journal*, April, 1921.

*Determination of the Direction of Atmosperic Disturbances or Static in Radio Telegraphy.*—L. W. AUSTIN.—Observations on the character of static disturbances in various parts of the country, with particular reference to directional effects and frequencies.—*Journal Franklin Institute*, May, 1921.

# News of the Industry

**Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions**

## Illinois Commission Bill Passes

JUST before adjournment last Saturday the Illinois State Legislature passed the pending utilities bill. It has not yet been signed by Governor Small. A superficial study of the bill as passed disclosed no objectionable changes made in the present utility commission situation. The commission under the act will become the Illinois Commerce Commission, with seven commissioners in place of the present five and eight assistant commissioners corresponding to the present examiners. Any municipality desiring home rule can call an election on petition of 25 per cent of the legally registered voters, but this petition must not be initiated by city authorities. Even after home rule is thus assumed utilities have the right of appeal to the Illinois Commerce Commission and from there to the state courts.

Although the full effect of the bill will not be known until the amendments passed in the last-minute rush are analyzed, the general feeling is that the only changes made from the present law are needed improvements. Among the amendments passed is one providing for the holding of commission hearings in the county in which the complaint originates.

## New York Water-Power Board Organized

IN ACCORDANCE with the water-power law passed this year by the New York Legislature, a State Water-Power Commission, composed of the chairman of the House and the President of the Senate, has been General, the State Engineer and Surveyor, the Speaker of the House and the President of the Senate, has been organized and is holding meetings. F. P. Williams, a consulting engineer, has been engaged as secretary.

The commission has issued a book of rules to guide those filing applications for permits, and up to the first of the week had received twenty-two applications.

The commission is proposing to make a study of the way in which it shall derive revenue from future water powers. Just at present it remains to be decided by the Supreme Court whether the state or the federal government shall exercise jurisdiction over the St. Lawrence and Niagara rivers. In the meantime those who have filed on New York waters in Washington are also filing in Albany.

## American Standards Committee Designates Sponsors

ANNOUNCEMENT is made this week by the American Engineering Standards Committee of the appointment of sponsors for the formation of sectional committees on a number of electrical standards. They are as follows:

American Institute of Electrical Engineers for "standard of aluminum for conducting purposes."

American Institute of Architects, American Institute of Electrical Engineers and the National Association of Electrical Contractors and Dealers jointly for "symbols for electrical equipment of buildings and ships."

United States Bureau of Mines for "safety rules for installing and using electrical equipment in bituminous-coal mines," "portable electric mine lamps" and "storage-battery locomotives for use in gaseous mines."

## Long Distance Transmission Gets Special Attention at A. I. E. E. Convention

ON TUESDAY of this week the thirty-seventh annual and tenth Pacific Coast convention of the American Institute of Electrical Engineers opened in Salt Lake City with the address of President A. W. Berresford. Besides touching on the essentials of research which must always form the basis of engineering development, he discussed with broad vision the commercial engineering responsibilities which engineers are now realizing they must assume. In considerable detail he outlined his conception of the proper sphere of activities of such bodies as the United States Bureau of Standards in order to eliminate misunderstandings and correlate in an effective way all the work of such bodies with that of corporate and university laboratories in the public interest. (An abstract of his address will be found on page 1469 of this issue.)

In the two days before this issue of the ELECTRICAL WORLD went to press the discussion dealt with phases of hydro-electric generation and high-tension transmission. Eminent engineers from the West and East showed great interest in papers covering the development at Niagara Falls as brought out by J. L. Harper and J. A. Johnson of Niagara Falls, N. Y., and the progress in waterwheel engineering summarized by W. M. White of the Allis-Chalmers company as typified by such installations as those at Pit River, Caribou and the Canadian and American Niagaras.

The discussion of long-distance transmission lines by F. G. Baum, consulting engineer of the Pacific Gas & Electric Company, added an exhaustive treatise to his many original contributions to the Institute during the past twenty years on voltage regulation and insulation of high-voltage transmission lines. This paper was one of three of a symposium on long-distance transmission systems. Another, by W. W. Lewis of the general Electric Company, dealt with line tests, and the third, by L. L. Elden of the Edison Electric Illuminating Company of Boston, took up the operation of interconnected systems. The discussion of these papers was largely on details of the theoretical fundamentals presented and emphasized the need of constant-voltage transmission and flat regulation on long lines, together with accurate information on the operating characteristics of grounded and isolated circuits.

Three remaining papers, by L. E. Imlay of the Superpower Survey, Raymond Bailey of the Philadel-

phia Electric Company and E. H. Fritz of the Pittsburgh High-Voltage Insulator Company and G. I. Gilchrest of the Westinghouse Electric Company, dealt with transmission from the standpoint of the Eastern superpower system, connections between generating systems and the design and production of suspension insulators.

H. T. Plumb, engineer General Electric Company, as chairman showed marked ability in conceiving and executing an entertainment program especially fitting to the engineering interest of the delegates as well as in acquainting them with the majestic setting of the convention city and its place in the industrial empire of the West. Features of this program were special excursions by automobile and train to substations of the Utah Power & Light Company, over drives in the Wasatch Mountains and to the mines and smelter of the Utah Copper Company, which operates the largest surface copper mines in the world. Visiting ladies were elaborately entertained. In addition to several auto tours there were dancing and musicals in the Utah Hotel and luncheons at prominent clubs.

## To Lay Plans for New N. E. L. A. Year Next Week

MEMBERS of the new executive committee of the National Electric Light Association and of the executive committees of all the national sections except the Commercial Section are scheduled to meet in New York next week to lay plans for the new administrative year. The Commercial Section executive committee will meet at Association Island July 22 and 23.

On June 28 the executive committee of the association will meet with the American Gas Association to consider those parts of the uniform classification of accounts that touch both kinds of service.

The following day President-elect Milan R. Bump will meet his executive committee to consider plans, scope of activities of association and at headquarters development of departmental activities, recommendations made at the Chicago convention, consolidation of work of some committees and selection of individuals for the general and special national committees.

The executive committees of the Technical and Public Relations Sections have been called for June 30 to consider similar section matters.

## Electrical Safety Conference Continues Work on Standards

AT A MEETING of the Electrical Safety Conference in New York on June 17 the various joint committees which have been working on safety standards for switchboards, rotating electrical machines and oil circuit breakers presented progress reports.

Tentative plans for the oil-circuit-breaker standards were discussed at the meeting. Recommendations on guarding line and current-carrying parts and on protection from fire and safety hazards and definitions of types, such as those for indoor and those for outdoor location, will probably be part of the final draft.

The safety standards for industrial control equipment are now available in published form and may be procured from the Underwriters' Laboratories in New York. The report on rotating electrical machines will soon be ready for ratification and the work on switchboards is well advanced.

## Public Relations Emphasized at North Central Meeting

APPOINTMENT of a joint committee to further co-operation with the telephone interests, of a committee to study the rural-service problem and co-operate with the Wisconsin Electrical Association committee and of a committee to study the California co-operative movement and the subject of joint pole construction was recommended by President T. D. Crocker in his address to the North Central Geographic Division of the National Electric Light Association at Duluth, Minn., on Wednesday of this week. The need of furthering good public relations in such a way as to prevent political attacks on utilities was also emphasized, and the importance of the companies gaining the confidence of their own employees as a basis for successful public relations work was urged.

Increased thrift and decreased production and transportation costs were given by J. H. Ingwerson of Duluth as the basis for a return of prosperity in discussing business conditions in the Northwest. Mr. Ingwerson made a strong plea against any modification of the federal reserve act that would materially change its present character. Improvement of conditions as fall advances, if crops are good, was looked for by the speaker, but he expressed the view that conditions in 1922 would be better than those this year.

R. A. Gantt, chief engineer of the Northwestern Bell Telephone Company, and C. B. Randall, counsel and secretary of the Tristate Telephone & Telegraph Company, in treating of the relations between power and telephone companies, emphasized the need of co-operative work and the importance of keeping out of court.

The convention was addressed by Martin J. Insull, retiring president of the National Electric Light Association. Tuesday was devoted to registration and a trip to the hydro-electric plant of the Great Northern Power Company on the St. Louis River.

## State Information Committee Movement Spreads to the South

ORGANIZATION of state public utility information committees has spread to the South. George F. Oxley, director of publicity of the National Electric Light Association, who was engaged last week in helping the organization of these committees, reports the Georgia organization completed and the expectation that the Alabama committee will open headquarters in Montgomery not later than Aug. 1. All of the larger Georgia utilities have shown an active interest and have pledged support.

The Georgia committee has appointed L. K. Starr, until recently city editor of the Atlanta *Journal*, executive secretary. The executive committee, which will direct the work, is composed of George T. Smith, Augusta-Aiken Railway & Electric Corporation, chairman; P. S. Arkwright, Georgia Railway & Power Company, vice-chairman; C. D. Flanigen, Athens Railway & Electric Company; F. L. Marshall, Gas Light Company of Augusta; H. C. Foss, Savannah Electric Company; P. R. Bomeisler, Ware County Light & Power Company; L. A. Magraw, Macon Railway & Light Company, and L. K. Starr.

S. B. Irelan, vice-president and manager of the Montgomery Light & Water Power Company, will have charge of the organization of the Alabama committee.

## State Water-Power Conferences to Be Held in Pennsylvania

ARRANGEMENTS for a series of conferences on ways and means to develop and conserve Pennsylvania's water-power resources were made at Harrisburg recently at a meeting of men interested in such projects. Gifford Pinchot, Commissioner of Forestry for Pennsylvania, outlined a state policy embracing fifty-year grants and renewals, the state water-supply commission to act with the commissioner. Mr. Pinchot was authorized to communicate with the Secretaries of State of various states to compile laws on the subject.

## New Officers of Canadian Electrical Association

AT THE closing session of the convention of the Canadian Electrical Association held in the city of Quebec last week the following officers were elected: President, Julian C. Smith, Shawinigan Water & Power Company, Montreal; first vice-president, P. T. Davies, Southern Canada Power Company, Montreal; second vice-president, A. P. Doddridge, Quebec Railway, Light, Heat & Power Company; third vice-president, L. W. Pratt, Hamilton-Cataract Light & Traction Company; secretary-treasurer, Eugene Vinet, Shawinigan Water & Power Company. The executive committee is composed of the officers and the following members: A. Monro Grier, Canadian Niagara Power Company; C. T. Barnes, Toronto & Niagara Power Company; R. J. Beaumont, Shawinigan Water & Power Company; A. A. Dion, Ottawa Electric Company; D. H. McDougall, Toronto Power Company; J. S. Norris, Montreal Light, Heat & Power, Cons.; J. B. Woodyatt, Southern Canada Power Company; W. L. Weston, Nova Scotia Tramways & Power Company, and representatives chosen by the Canadian General Electric Company, the Canadian Westinghouse Company, the Sangamo Electric Company and the Northern Electric Company.

## Script Dividends Bring Big Drop in Cities Service Stock

ONE of the biggest smashes in security prices came last week in Cities Service stock as a result of the decision of its board of directors to issue scrip dividends on all classes of stocks to conserve cash resources in order to meet abnormal conditions in the oil industry. Prior to the meeting of the board on June 10 the common was selling around 215. The following day it broke to around 140 and on Monday it sold down to 110. It was recognized, however, that the drop had been too precipitous and on advice of reassuring news from the office of Henry L. Doherty & Company the stock went up to over 130 by the close of the week. This week, however, saw fresh selling spurts and as the paper goes to press the common is selling down to around 120.

The preferred, which is 6 per cent cumulative, also broke. It had been selling around 63½. The news caused it to go down below 40. It recovered to almost 50 and during this week was off again about 5 points from its high of the previous week.

Mr. Doherty pointed out that the net earnings of the public utility subsidiaries are at the highest point in their history. Net earnings for the twelve months ended May 31, 1921, were $20,577,867 as compared with $20,735,416 for the similar period a year previous.

Cities Service Company controls through stock ownership twenty-six oil subsidiaries and seventy-nine public utility subsidiaries. Its oil production in 1920 was in excess of 13,600,000 barrels. Its utility subsidiaries supply electric light and power, natural and artificial gas, street railway and other service to more than 350 communities in twenty-one states and Canada.

## A. I. E. E. Standards Submitted for Approval

THE American Institute of Electrical Engineers has submitted its "Standards" (1921 edition) to the American Engineering Standards Committee for approval as American standard practice. The standards are submitted in accordance with the special provision in the procedure of the committee under which important standards adopted or in process prior to 1920 may be approved without going through the regular process followed in new work.

Standards recently approved by the committee include four copper specifications submitted by the American Society for Testing Materials as "tentative American standard," as follows: "Soft or annealed copper wire"; "Lake copper wire, bars, cakes, slabs, billets, ingots and ingot bars"; "electrolytic copper wire, bars, cakes, slabs, billets, ingots and ingot bars," and "battery assay of copper."

## Exhaustive Inquiry into Boston Edison Rates Expected

THE most comprehensive inquiry thus far made into the rate structure of the Edison Electric Illuminating Company of Boston appears in prospect from announcements made by counsel for the city of Boston at a resumed hearing June 15 before the Massachusetts Department of Public Utilities. The city has appropriated $50,000 to support the extra expenses of the inquiry. The city proposes to ascertain first whether the company's present income is too large, having in view a fair return of the property and allowance for proper operating costs, depreciation, etc., and, second, the effect of any apparent discrimination or inequalities in the functioning of the rate schedule.

## Patent Office Bill Reported Out Favorably

THE bill providing for an increase of force and salaries in the Patent Office, introduced by Representative Lampert, has been reported out by the House committee on patents with the recommendation that it be passed at the earliest possible date. The bill increases the salaries of the principal examiners in the Patent Office from $2,700 to $3,900 per year. Assistant examiners are allowed increases ranging from $150 per year to $900 per year.

The bill also increases the commissioner's salary from $5,000 to $6,000, that of the first assistant commissioner from $4,500 to $5,500, that of the second assistant commissioner from $3,500 to $5,000, that of chief clerk from $3,000 to $4,000, that of one solicitor from $2,750 to $5,000, that of five law examiners from $2,750 to $4,000, and that of two examiners of interferences from $2,700 to $5,000. Five members of the board of examiners in chief who are appointed by the President and who under the statute must have both scientific and legal training will be allowed an increase by this bill from $3,500 to $5,000.

## Federal Commission to Study Waste Elimination Proposed

A FEDERAL commission to study waste elimination in industry is proposed in a bill which has been introduced by Senator Calder. The bill is intended to continue and to amplify the survey made by the Federated American Engineering Societies at the instigation of Herbert Hoover, who until recently was president of that organization.

Senator Calder's bill provides that the commission is to be known as the United States Industrial Waste Commission and to have the Secretary of Commerce as chairman.

The commission is directed by the bill to make a final report on or before September, 1922, the report to cover waste in timber, power, transportation, oil, coal, essential minerals and other basic raw materials. There is reason to believe that the committee on commerce, to which the bill has been referred, will take prompt and favorable action on it. It is emphasized that no regulation is contemplated in this legislation and that there is not to be a suggestion of interference with private initiative.

The Superpower Survey is cited as an effort to eliminate waste. In the Boston-Washington industrial area some 17,000,000 hp. is being produced. Of this only 10,000,000 hp. is actually productive. The remaining 7,000,000 hp. either is wasted or is used to transport the fuel for the 10,000,000 hp. actually effective. The Superpower Survey is expected to show that the gradual development of an interlocking system of electrical transmission between superpower plants, to which coal could be transported economically, and a gradual development of hydro-electric plants would result in saving most of this 7,000,000 hp. In addition, byproducts could be saved and the transportation system correspondingly relieved.

## Public Relations the Dominant Topic of Northwest Convention

THE urgent need of better public relations, gained partly through improvement in the service rendered, partly by more carefully planned contact with the public and partly as the result of widespread accurate information as to the problems and needs of the electric utilities, was the keynote dominating the fourteenth annual convention of the Northwest Electric Light and Power Association (geographical division of the N. E. L. A.), held in Portland, Ore., June 15 to 18. This subject was dealt with in one form or another almost to the entire exclusion of others. In discussing this point E. V. Kuykendall, director of the Washington Department of Public Works, said that the average consumer attaches more value to the quality than to the cost of service, but that courteous treatment is prized above price and quality. In his opinion discourteous treatment of the public by company employees and lack of diplomacy should be classed with incompetency as cause for dismissal. He expressed the opinion that good-will advertising was largely valueless unless it explained the fundamentals of rate-making valuation and accounting.

In one of the most appreciated addresses of the convention M. H. Aylesworth, executive manager of the National Electric Light Association, emphasized the point that it is of the greatest immediate importance to hold all of the four branches of the industry together and bring them into harmonious working relations.

Outlining the plans of the newly formed Northwest Electrical Service League, S. I. Miller, its secretary-manager, made it clear that it was not intended to conduct merely a campaign but that a long period of steady growth was desired. Other speakers were G. L. Myers, who spoke on "Winning Public Support and Confidence"; Robert Sibley, whose subject was "Western Industrial Development"; C. E. Driver, who dealt with "Public Utility Securities," and L. T. Merwin, who talked on "The Essentials of Power Development."

Officers elected were: President, W. R. Putnam, vice-president and general manager Idaho Power Company; vice-presidents: For Washington, J. M. Kincaid; for Idaho, I. E. Rockwell; for Utah, P. M. Parry; for Oregon, G. L. Myers. C. M. Brewer, L. A. McArthur and L. B. Faulkner were elected members of the executive committee. The attendance approximated 150.

## Chicago Vehicle Men Plan Co-operative Association

AT A MEETING held June 10 in the offices of the Commonwealth Edison Company, Chicago, representatives of the electric vehicle industry formed a tentative organization for the purpose of pushing the sale in that city of electric trucks, passengers cars, tractors and batteries. E. W. Lloyd of the Commonwealth Edison Company, who presided, said after the meeting that the conference was the first step toward a permanent, stable association of vehicle men, an organization which can co-ordinate the present dissociated activities of the local dealers and manufacturers and by uniting their effort aid in putting the electric vehicle locally on its proper plane.

Mr. Lloyd offered the co-operation of the various Commonwealth Edison employees interested in electric transportation. He also stated that the Commonwealth Edison Company had in preparation an advertising campaign on electric trucks and transportation and would gladly help in a newspaper advertising campaign, standing its share of the expense.

A number of suggestions were made, including the need for a central bureau to supply reliable statistics relative to electric truck performance and maintenance, the desirability of a slogan such as "Electrics for economy!" a newspaper advertising campaign, a large loop garage to encourage the use of passenger cars, the concentration of the efforts of all dealers on a certain line of business for a certain period and the classification of users as well as prospective users. A number of other suggestions were made, and it was decided that all these questions would be taken up at the time the organization was perfected.

Twelve dealers and manufacturers were represented as follows: Mercury Manufacturing Company, Detroit Electric Car Company, Commercial Truck Company, Walker Vehicle Company, Ehrlich Electric Truck Company, Electric Tractor Company, Electric Storage Battery Company, Northwestern Electric Company, Automatic Transportation Company, Edison Storage Battery Company, Harry Salvat, Milburn and Ward electric vehicle distributer, and Schaefer Brothers. Meetings of a sub-committee appointed to determine the form of the organization were scheduled for a later date. It has been suggested that the association be called the Electric Automotive Trade Association.

## Tentative Draft of Water-Power Licensees' System of Accounts Issued

THE tentative draft of rules and regulations for the establishment and maintenance of a system of accounts for licensees under the federal water-power act has been printed by the federal power commission for purposes of discussion only. O. C. Merrill, executive secretary of the commission, says in his explanation of these rules that they are based on those proposed by the committee on statistics and accounts of public utilities of the National Association of Railway and Utilities Commissioners, many of its recommendations having been adopted as they stood, others slightly modified and a few materially changed. Modifications were necessary in order to bring the accounting requirements into conformity with the provisions of the act or the commission's regulations, particularly the regulation relating to depreciation reserves. Comment, suggestions and criticisms may be filed with the commission up to Aug. 15, and a hearing will be had by the commission subsequent to that date.

## Utilities Entitled to Fair Return Even in Periods of Depression

A PUBLIC utility is entitled to earn a fair rate of return in bad times as well as good. This was the gist of a very interesting decision recently handed down by the Public Service Commission of Indiana. In granting higher rates to the Illinois Bell Telephone Company the commission said:

"Although the commission hesitates to increase rates at a time when business generally is depressed and prices show a tendency to decrease, it cannot deny an increase in rates to a utility which has not earned a reasonable return in recent years; which furnished service throughout the war period at less than cost, while unregulated private corporations were making large profits; whose reasonable requirements for an estimated year are $215,660 in excess of its estimated revenues under present rates, and which is efficiently and economically managed, since the utility must continue to give service, extend its lines and improve its equipment, and the only source of revenue and credit is derived from the subscribers and patrons who pay the rates.

"It is contended that in times of business depression a public utility should be required to forego its profits and take its losses like any private corporation. This might be all right if during hard times a public utility were permitted to close its doors and suspend operation until business conditions became promising. It might be still more logical if a utility were permitted during boom times to enjoy large earnings and pay out its profits in dividends.

"Regardless of the state of business generally, a utility must continue to operate at maximum speed. It must continue to give service, for its service has become one of the necessaries of life. It must constantly extend its lines and add to and improve its equipment in order to keep up with the growth of its community and the developments of the art. The public demands these things.

Their cost is great and will probably never again be at the pre-war level. As time passes and improvements are developed the service demands become more complex and insistent. There is but one source of revenue and credit, and that is from the subscriber and patrons who pay the rates. Like most public utilities, the petitioner is a large borrower of money for its improvement program. In order to borrow money at all it must have credit. Regardless of its credit, the cost of borrowed money today unfortunately is extremely high.

"A utility is entitled under the law to earn sufficient revenue to meet its necessary operating expense and pay a reasonable return on the value of its property. This the petitioning utility has not been able to do for several years with the rates it has had in effect. Under the circumstances the commission has no choice under the law but to increase the rates."

## Arrange for International Co-operation on Standardization

THE secretary of the American Engineering Standards Committee, Dr. P. G. Agnew, has just returned from a short trip to Europe, where he went to attend a conference in London of the secretaries of the national standardizing bodies. After the conference he visited France, Switzerland and Germany for a more detailed study of the standardization work in those countries.

The conference had for its object an interchange of experience and the furtherance of co-operation between the various national bodies in their work of industrial and engineering standardization. The secretaries will submit the suggestions of the conference to their respective organizations for approval. These have to do with the interchange of publications, a reciprocal arrangement for making foreign standards available to the industries of each country through their sale by the offices of the national bodies, the exchange of information as to the status of work in progress, and other methods of furthering co-operation between the national bodies.

It was the view of the conference that international co-operation in industrial standardization work should proceed along such informal lines being based primarily upon the interchange of information on active subjects of mutual interest, rather than by any attempt at the present time to form a general international standardizing body; that in cases in which formal organization should be found necessary the organization should preferably be by subject or industry, somewhat along the lines of the International Electrotechnical Commission; but that in all cases efforts should first be made to gain results by less formal methods, and to this end it would often be desirable that in a given subject the office of one of the national bodies most interested should, by informal agreement, perform such secretarial functions as would further international agreement in the particular subject.

Arrangements are being made for close co-operation between the national standardizing bodies and the International Chamber of Commerce, which will give special consideration to the subject of standardization at its convention which is to be held in London the week of June 27.

The secretaries present and the countries they represented were: Belgium, G. Gerard; Canada, R. J. Durley; Great Britain, C. le Maistre; Holland, E. Hijmans; Norway, A. Eriksen; Switzerland, M. Zollinger; United States, P. G. Agnew.

## Bill to Exempt Leased Electric Devices from Execution for Rent Vetoed

AN ACT passed by the Pennsylvania Legislature to exempt electric household equipment, including washing machines, vacuum cleaners, ironing machines, dish-washing machines, sewing machines, portable lamps, refrigerating machines, flatirons, vibrators, heaters, ranges or water heaters, which have been leased or hired from sale on execution for rent has been vetoed by the Governor. The strongest opposition came from the department-store interests.

In 1909 the Pennsylvania State Association of Electrical Contractors and Dealers was responsible for a similar act being approved applying to electric motors, dynamos and fans. The act just vetoed simply kept step with the development of electrical appliances, which have been sold on the time or deferred-payment plan of merchandising in large degree.

## Company Finds It Cannot Dispose of 5 per Cent Bonds

THE Indiana General Service Company and the American Gas & Electric Company have jointly petitioned the Indiana Public Service Commission for authority to issue $2,368,500 worth of 7½ per cent bonds. The American Gas & Electric Company owns nearly all of the common stock of the Indiana company and a considerable part of its preferred stock and now has $2,368,500 worth of 5 per cent bonds of that company.

The American company says in its petition that it cannot dispose of these bonds because of the low interest rate. The two companies petitioned the commission for authority to issue the same amount of bonds at 7½ per cent interest, which the American Gas & Electric Company is to take over and sell for the Indiana General Service Company.

## "Better Illumination" Exhibition Makes Good Start at Boston

UNDER the auspices of the Massachusetts Institute of Technology, the New England Division of the National Electric Light Association, New England Electrical Supply Jobbers' Club, New England Section of the Illuminating Engineering Society, New England Electrical Sales Associates, Massachusetts State Branch of the National Association of Electrical Contractors and Dealers, and other manufacturers, engineers and architects interested in lighting practice, a "Better Illumination Bureau" was opened June 15 at the Rogers Building, Boston, to continue at least one year. A number of leading electrical men assembled the previous day for a private view of the display.

In the Boston display forty-nine circuits and ninety outlets with varied fixtures have been installed in a room, 49 ft. 7 in. long by 28 ft. wide, on the first floor of one of the principal buildings in the old home of the Massachusetts Institute of Technology. The exhibit is within about ten minutes' walk of the downtown district and, like its predecessors at other large cities, is designed to show flexibility for demonstration examples of good and bad lighting, with opportunities for illumination measurement and regular lectures by experts upon various phases of industrial and commercial lighting.

A. L. Powell, illuminating engineer Edison Lamp Works of the General Electric Company, Harrison, N. J., gave the first lecture, and Prof. W. J. Drisko of the Massachusetts Institute of Technology touched upon the significance of this and other forms of co-operation between that institute and industry.

It is estimated that the cost of mairtaining this exhibit, including the installation expense, will be about $5,000 for the first year and $2,500 for each succeeding year in case sustained interest warrants its continuance.

The various interests that were mentioned above have subscribed funds to establish and carry on the work for at least a year, and a careful system of following up the "prospects" developed by visits of interested persons will be put into effect at once. This includes memoranda from the bureau to the sources of information regarding actual visitors and periodical "check-ups" of better lighting installations resulting from the display, along with estimates of the new business derived, energy sales, etc.

ELECTRICAL MEN VIEW EXHIBIT BEFORE PUBLIC OPENING

Back row, standing left to right—Julius Daniels, illuminating engineer; A. L. Powell, illuminating engineer, Harrison, N. J.; Howard S. Knowlton, New England editor ELECTRICAL WORLD and *Electrical Merchandising;* Prof. George P. Bacon, Tufts College.

Middle row, standing left to right—J. J. Caddigan, E. C. Kimball, L. L. Edgar, L. D. Gibbs, Boston Edison Company; Donald W. McIntosh, Union Electric Supply Company, Providence, R. I.; N. J. Campbell, Edison Electric Illuminating Company of Boston; Frank J. Allen, Westinghouse Electric & Manufacturing Company; H. Cairnie, J. F. Davis, Western Electric Company; J. C. D. Clark, Boston Consolidated Gas Company; C. S. Davis, Westinghouse Lamp Company; William Coale, National Lamp Works; H. G. McConnaghy, Boston Edison Company; D. C. Gidley, Crouse-Hinds Company.

Seated, left to right—R. S. Hale, Edison Electric Illuminating Company of Boston; Merle R. Griffeth, General Electric Company; S. E. Doane, National Lamp Works; Prof. W. J. Drisko, Massachusetts Institute of Technology; J. C. Norcross, Edison Electric Illuminating Company of Boston; E. M. Coffin, Associated Industries of Massachusetts; W. H. Atkins, general superintendent Edison Electric Illuminating Company of Boston; J. E. Wilson, secretary Bureau for Better Illumination; H. F. Wallace, president Bureau for Better Illumination; J. S. Patrick, Benjamin Electric Manufacturing Company; C. A. Strong, Westinghouse Lamp Company; C. H. Parker, Edison Electric Illuminating Company of Boston.

## Indiana Company Would Increase Capital by Two Classes of Preferred Stock

THE Southern Indiana Gas & Electric Company has filed with the Secretary of State a notice of increase of its capital stock from $6,000,000 to $10,000,000. The company wishes to issue its increase of $4,000,000 in two classes, the first $2,000,000 to be 6 per cent preferred stock and the second $2,000,000 to be 7 per cent preferred stock.

## American Electrochemical Society Plans Electrodeposition Division

THE American Electrochemical Society recently appointed a committee to investigate the possibility of forming a division upon electrodeposition. The purpose of such a division will be to hold meetings in connection with the semi-annual meetings of the society and thereby to encourage the presentation and discussion of papers upon the electroplating, electrotyping, electrorefining and electro-analysis of metals, and the electrodeposition of metals for any other purposes. If a sufficient number of members express their desire to join such a division, its formation will be authorized by the board of directors, and temporary officers will be appointed by it pending an election to be held at the next general meeting.

## Radio Station in China Rated at 1,000 Kw. to Be Started at Once

DIRECT radio communication between Shanghai, China, and San Francisco—a distance of 5,360 nautical miles—is to be made possible by a 1,000-kw. arc station at Shanghai, construction of which is to start at once and which is to be completed within nineteen to twenty-four months. Contract for the construction of the plant, which will be similar to the station at Bordeaux, France, has been signed with the Federal Telegraph Company. A similar station is to be erected at San Francisco, and when both are completed they will, together with the Bordeaux station, constitute a chain by means of which messages can be transmitted entirely around the world. The separation of the three stations is almost exactly 120 deg. of longitude.

Although the power of the Shanghai unit will not be greater than that of the station at Bordeaux, several improvements, it is announced, will be incorporated in it. Among these are the "uni-wave" signaling system, which is expected to afford a distinct advantage for long-distance communication by improving the clarity of the signals.

## Questionnaire on Taxation Submitted to 1,400 Business Organizations

A SERIES of questions on taxation has just been submitted to a referendum vote of the 1,400 business organizations within the membership of the Chamber of Commerce of the United States. The vote is on proposed forms of taxation and does not deal with amounts of revenue to be raised. The purpose of the referendum is to fix the national chamber's position on the forms of levy which might be used if needed to replace revenue lost through the proposed repeal of the excess profits tax, to determine an attitude with respect to the continuance of war excise taxes, and to get opinion as to the form of taxes that might be substituted for excise taxes if the revenues now derived from them have to be replaced.

One probable result of the vote will be to determine the chamber's position as to a sales tax, on three forms of which members are asked to vote. The referendum is supplemental to one taken last winter, which did not result in a decision respecting all questions asked. The first referendum brought a decision as to treatment of increments to capital income, questions of net and inventory losses, administration, etc. The present referendum is confined to forms of taxation which had prominence at the chamber's last annual meeting, held at the end of April in Atlantic City.

## Los Angeles Gas & Electric in $3,500,000 Financing

A NEW issue of $3,500,000 of general and refunding mortgage 7 per cent gold bonds, series B, due 1931, of the Los Angeles Gas & Electric Corporation came on the market this week at 97½, to yield over 7.35 per cent. The new issue is marketed callable for five years. The proceeds are to provide for betterment and additions.

## Northern States Sales Manager Reports Large Power Business

ASSERTING that negotiations for new electric power business at profitable rates have never been carried on on such a large scale as at the present moment, H. E. Young, sales manager of the Northern States Power Company continues:

"Changes in operating costs have affected small isolated plants much more seriously than large plants like ours and consequently a large number of municipally operated as well as privately operated small electric plants, in the smaller towns, find their operating expenses prohibitive, and the number of negotiations now being carried on for serving this kind of business by a single town or group of towns getting together and building transmission lines to our lines is much greater than was ever known before. The effect of present conditions applies similarly to industrial plants now generating their own power, and many of these with which we could not formerly compete satisfactorily are now good 'prospects' for the sale of large amounts of central-station power."

## Extensive Additions to Louisville Generating Station Planned

AMONG the features of an enlarged construction program announced by the Standard Gas & Electric Company are extensive additions to the Louisville (Ky.) Gas & Electric Company's Waterside generating station to be made next year. These additions will cost between $2,500,000 and $3,000,000. The necessity for this enlargement of the power plant is clearly shown by the fact that its annual output in 1920 was 108,118,000 kw.-hr., as compared with 85,783,000 kw.-hr. in 1919. Since 1916 the output has increased about 100 per cent.

## Utility Taxes in Indiana to Be Less

INDIANA utilities, including street railway, interurban, gas and power companies, will pay less taxes next year, generally speaking, than they have paid for some years back. Recent rulings of the Indiana state tax board have cut down the assessed valuations of the utilities generally. Only in one or two instances has an increase been made. The valuation of the Interstate Public Service Company has been increased from approximately $3,500,000 to more than $5,000,000, but this was because of a recent merger of the company, which took into one corporation about eight smaller utility companies.

# Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest

**British Electrical Engineers Return to Own Building.**—The Institution of Electrical Engineers has removed its offices, returning to its own building on Savoy Place, Victoria Embankment, London.

**Newark Revises Its Electrical Safety Rules.**—A booklet has just been issued by the electrical bureau of the division of buildings of the Newark (N. J.) Department of Public Safety containing the city's revised rules for the installation of interior wires, fixtures and apparatus.

**Intercollegiate Radio Service.** — The University of Texas at Austin and the Texas Agricultural and Mechanical College at College Station now exchange college news by wireless, and it is planned to extend the interchange of information to take in colleges in other states, including Harvard and Yale.

**Hydro-electric Power in Argentina.**—Recently published details on the Argentine government's scheme for utilizing the Iguazu Falls and the Salto Grande for the generation of hydro-electricity represent the available head of water as varying from 154 ft. to 280 ft. and the flow as ranging from 12,000 cu.ft. to 250,000 cu.ft. a second. The average flow is put at 50,000 cu.ft., and it is estimated that the development would mean a fairly constant output of 370,000 hp., most of which would be taken by Buenos Aires.

**Wireless in Latin America.**—Announcement has been made that one of the most powerful wireless stations in the world is soon to be erected at Buenos Aires to operate between Argentina and Europe. There will be six 689-ft. towers, and the station is to be erected under contract with the Telefunken Radiographic Company of Germany. In Mexico the government has approved of the erection of thirty additional wireless stations and has besides overhauled and put in good condition the twenty-seven stations now in operation in that country.

**East Indian Student of Shakespeare Turns His Attention to Street Lighting.**—Neglect on the part of the municipal authorities of Madras, India, to fit a new ornamental post with an electric lamp very properly brought down upon them the following rebuke from a native of a literary turn of mind who none the less has an eye for practical affairs: "Last night Vinayaga Maistry Street was enveloped, as it were, in total darkness, when the iron tongue of time told two in the drowsy ear of night, in spite of the existence of a lamp post in fairly good working order. The needful must be done at once. If it were done when it is done, then it were done quickly. We cannot but look up with an air of resignation, characteristic of an Oriental, to the corporation to do the needful in this behalf before the dark fortnight dies into the shade, ushering in the bright daughter of the month to dance into light."

**Wireless from Flanders.**—A site has been selected in the province of Flanders, Belgium, on which it is planned to erect one of the most powerful wireless station in the world. This station will be capable of communicating with North America during the whole of the twenty-four hours, with the Argentine Republic during twelve hours and with the Congo, where the unfavorable atmospheric conditions of the equatorial regions prevail, eight hours. It is estimated that 60,000 words will be transmitted each day.

**Secretary Hoover Approves School of Pan-American and Foreign Commerce.**—Secretary of Commerce Hoover has expressed approval of the efforts at instruction in the fundamentals of foreign trade that are being made by the School of Pan-American and Foreign Commerce, with headquarters in New York City. This school, of whose advisory board Dr. Leo S. Rowe, director-general of the Pan-American Union, is chairman, is holding a "Plattsburg for Business" in Washington from June 20 to July 10 along the same lines as the one held last year.

**Oklahoma Utilities Use More Gas than Any Other State.**—Oklahoma utilities consumed more natural gas in the production of electricity during January and February, 1921, than was used by utilities in any other state in the Union. As shown by a recent report of the United States Geological Survey Oklahoma consumed 408,287,000 cu.ft. in January and 399,520,000 cu.ft. in February. West Virginia stood next to Oklahoma with a natural-gas consumption for manufacture of electricity of 278,447,000 cu.ft. in January and 263,988,000 cu.ft. in February. Ohio held third place.

**War Work of the Bureau of Standards.**—From the Department of Commerce comes a 300-page publication containing brief descriptions of the investigations and tests conducted by the Bureau of Standards during the war which were of service to the military departments. Photographs illustrating the apparatus used are given in some cases. Among the investigations described are those on aerouautic instruments and power plants, calibration of testing machines, coke ovens, electric batteries, electric blasting apparatus, electric tractors and trucks, electrical inductance for location of metal bodies, illuminating engineering, magnetic and metallurgical researches, radio communication and radiometry, searchlights, telephone problems and X-rays.

# Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

**American Electric Railway Association.**—The annual convention of this association will be held at Atlantic City, N. J., during the week beginning Oct. 3. On account of the business depression the exhibits this year will be abandoned.

**Electrical Association of Nova Scotia.**—The newly formed Electrical Association of Nova Scotia has elected these officers: President, W. Murdoch, manager Northern Electric Company; vice-president, P. R. Colpitt, city electrician of Halifax; honorary secretary-treasurer, J. T. Dorey, president Dorey Electrics, Ltd.

**Salt Lake City Named for 1922 Convention of American Association of Engineers.**—The 1922 convention of the American Association of Engineers will be held in Salt Lake City. In the selection of the place for this meeting three cities were voted upon, and Salt Lake was first choice, Norfolk, Va., second, and Philadelphia third. The convention will take place in May of next year, and it is expected that more than 500 delegates will attend.

**Engineering Society of Akron.**—Officers elected for the ensuing year by the Engineering Society of Akron, Ohio, are as follows: President, J. H. Vance, superintendent of power for the B. F. Goodrich Company; vice-president, L. G. Tighe, superintendent of power production and distribution for the Northern Ohio Traction & Light Company; directors (to serve two years), R. R. Metheany and H. G. McGee. The board of directors includes in addition Burt Waltz and Benton Dales, whose terms expire next year, and Past-presidents Fred Ayes and Gale Dixon.

### Coming Meetings of Electrical and Other Technical Societies

Associated Manufacturers of Electrical Supplies — New London, Conn., June 27-30.

Society for the Promotion of Engineering Education — New Haven, Conn., June 28-July 1.

Ohio Electric Light Association — Cedar Point, Ohio, July 12-15.

National Association of Electrical Contractors and Dealers—Buffalo, July 18-22. (For program see issue of April 30, page 1010.)

American Physical Society, Pacific Coast Section—Berkely, Cal., Aug. 4 and 5.

N. E. L. A., New England Division—New London, Conn., Sept. 6-9.

N. E. L. A., Great Lakes Division—French Lick Springs, Ind., Sept. 14-16.

Association of Iron and Steel Electrical Engineers—Chicago, Sept. 19-24.

Illuminating Engineering Society—Rochester, N. Y., Sept. 26-30.

American Electrochemical Society — Lake Placid Club, N. Y., Sept. 29-Oct. 1.

American Electric Railway Association—Atlantic City, N. J., Oct. 3-7.

# Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

**Status of Public Utility Leased to Private Company by Municipality.**—The Illinois Public Service Commission, which has no jurisdiction over rates for electric service furnished by a municipal plant, has determined that a public utility leased by a municipality to a private company is none the less municipally owned and therefore not under the commission's jurisdiction.

**Effective Date of Rate Changes.**—The New York Public Service Commission recently adopted the following ruling: "A bill for gas or electricity or service covering a period during which a change in rate has become effective shall be based on the later rate only from and after the next meter reading subsequent to its effective date. A monthly service charge shall be deemed to cover a period of not less than thirty days after effective date and shall not be billed in advance."

**New York Commission Criticises Salaries.**—Granting to the Hammondsport Electric Light Company a rate of 11 cents per kilowatt-hour instead of the 15-cent rate requested by the company, the New York Public Service Commission held that $4,700 was too great a charge for salaries and that the item should be reduced to $2,400. The company in 1920 had an output of 131,500 kw.-hr., with 373 meters in use. Its capital investment, the commission held, could fairly be put at $20,000.

**Rates Ordered to be Lowered at Galena, Ill.**—The Illinois Public Utilities Commission has ordered the Interstate Light & Power Company, which serves Galena and vicinity, to make a reduction in its power rates pending a final determination of a proper schedule. The commission based this order, it was announced, upon a reduction in the price of coal and imposed a scale ranging from 6½ cents per kilowatt-hour for the first 1,000 kw.-hr. a month down to 2½ cents for consumption in excess of 20,000 kw.-hr.

**Hawaii Commission's Attitude on Proper Rate Basis.**—In a recent gas-rate decision the Hawaii Public Utilities Commission thus reiterated its view on what constitutes a fair rate: "This commission has uniformly held that a public utility adequately serving the public is entitled to charge such rates as will yield over and above operating expenses, including a depreciation reserve, a fair return upon the property actually devoted to the public service, subject to the limitation that such rates must not be more than the service is worth."

**Cost Plus 20 per cent to Be Rate for Energy Paid by Railways to Supply Company.**—The Illinois Public Utilities Commission has ruled that the rate to be paid the East St. Louis Electric Light & Power Company by three railway companies which purchase electrical energy from it shall be the actual cost of the power purchased plus 20 per cent.

**Regulation of Dual Utility Where Virtually All Customers Consume Both Commodities.** — Stability of operating costs during temporary fluctuations in one department of a combined gas and electric utility supplying service in a community where the consumers of one commodity were to a large extent consumers of the other was advanced as the reason for not segregating these departments in a rate proceeding before the Arizona Corporation Commission affecting the Central Arizona Light & Power Company. In the special case of the city of Phoenix, the commission held, a considerable benefit would result for the consumers if the commission regulated the gas and electric businesses as one utility instead of separately as two utilities. As a result of combined regulation the temporary fluctuations in operating costs of one utility would be stabilized so that the rates of one commodity would not have to be advanced until the return on the property employed in both utilities became less than the minimum allowable return. Such a procedure, however, the commission granted, would not be equitable where the two commodities were not so generally used by the same persons.

**Vermont Commission Orders Fuel Charge Eliminated.**—In refusing, on the protest of the granite manufacturers and quarriers of the Barre district, to sanction the addition of a fuel surcharge to the rates of the Montpelier & Barre Light & Power Company, the Vermont Public Service Commission said: "A schedule of rates which leaves to the company power to increase or diminish its charges according to some variable circumstances in its discretion does not furnish to the customer that information which the law contemplates. Rates established by such a method are not fixed by law, but by the will of the company. The proposed fuel charge, if in operation, would place the matter of determining the times when and conditions under which its steam generating plant should be used entirely in the hands of the defendant corporation and in effect render the defendant instead of the authority constituted by the Legislature the rate-making power. To state the effect of the operation of the said fuel charge in another manner, it would amount to a delegation of the rate-making power from the authority constituted by the Legislature to the corporation." The commission also held that expenses incurred by the company in upholding before the commission its rate increase of 1919 were an improper charge to the operating expenses of 1920.

# Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

**Condemning Property Beyond State Limits.**—A decision of the Wisconsin Supreme Court in Superior Water, Light & Power Company vs. City of Superior permits Wisconsin municipalities to condemn the property of Wisconsin corporations in adjoining states, provided that there is nothing in the laws of the invaded state to prevent their doing so. By this decision Superior acquires the right to condemn property situated in Duluth, across the Minnesota line.

**Company Held Not "Willfully" to Have Failed to Make Report.**—The Danville Light, Power & Traction Company recently appealed to the Court of Appeals of Kentucky against a verdict against it and in favor of the commonwealth imposing upon it a fine for "willful" neglect to file a report with the State Auditor as required by law. The Court of Appeals reversed the verdict, finiding that the non-filing of the report was due to misinformation furnished to the responsible agent of the company from a subordinate to the effect that the report was duly filed, and that as soon as the mistake was discovered the report was at once prepared and filed, and that therefore the failure to file it within the date set by law was not willful neglect. (230 S. W. 38.)*

**Duty of Utility to Extend Service.**—In State ex rel. Ozark Power & Water Company vs. Public Service Commission of Missouri an appeal against an order of the commission requiring the company to furnish electric service to the inhabitants of Diamond, Newton County, was under review. The Supreme Court of the state found for the commission, declaring (1) that although a power company is not required to serve a community it has not undertaken to serve it can be required to serve a city within the territory it has undertaken to serve; (2) that where a company built a transmission line through a certain county, erected a substation a mile from a certain town and built distribution lines from this substation it could be required to serve the town in question and that the commission's order in the case was reasonable; (3) that the evidence showed the extension of service was warranted by the test of the existence of demand reasonably certain to justify commercially the preliminary expenditure entailed. (229 S. W. 786.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

# Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

**J. D. Kuster,** who was recently appointed manager of the San José division of the Pacific Gas & Electric Company of California, as announced in the ELECTRICAL WORLD, has been in the commercial organization of that company since 1902. Mr. Kuster was born in California in 1872 and attended

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Washington College. He became assistant manager of the Marysville district of the California Central Gas & Electric Company, which later became part of the Pacific Gas & Electric Company system. In November, 1902, he was made manager of the Colusa district of the same company, succeeding P. M. Downing. In 1906 he was appointed manager of the Fresno district of the Pacific Gas & Electric Company and in 1909 was transferred to San José, where he became manager of that district. When the commercial organization of that company was recently changed Mr. Kuster was promoted to his new position.

**T. B. Patton** has been elected vice-president of the Northern Virginia Power Company, Winchester, Va., to succeed the late Col. R. P. Chew.

**Fred S. Baldwin,** formerly general sales manager of Pass & Seymour, Inc., Solvay, N. Y., has become president of the Baldwin-Hall Company, Syracuse, N. Y., which has recently been incorporated to do a wholesale business in electrical supplies and machinery. Mr. Baldwin started the electrical department of the Syracuse Supply Company, which he operated for four years, after which he managed the New York office of Pass & Seymour, later becoming general sales manager.

**W. T. Neill,** formerly with the Public Service Commission of Oregon and recently in consulting engineering practice in Seattle, Wash., has accepted the position of rate engineer of the Pacific Power & Light Company of Portland, Ore.

**L. A. Bell** has been appointed local manager of the St. Johnsbury (Vt.) division of the Twin State Gas & Electric Company, and John Ordway has been appointed manager of the Berlin (N. H.) division of the same company, whose headquarters are at Boston.

**David F. Houston,** Secretary of the Treasury in the Wilson administration, has become associated with the American Telephone & Telegraph Company. While his title has not been decided, his chief work with the company will be of a financial character. He took up his new duties June 1.

**William H. Hall, Jr.,** formerly district manager of the Chicago territory for Pass & Seymour, Inc., Solvay, N. Y., has become secretary and treasurer of the Baldwin-Hall Company, Syracuse, N. Y., which has been incorporated to do a wholesale business in electrical supplies and machinery.

**Ira Cushing,** formerly sales representative of the Electrical Engineers' Equipment Company at Boston and for eighteen years attached to the Boston office of the General Electric Company, has joined the staff of the Condit Electrical Manufacturing Company, 838 Summer Street, Boston, as sales engineer. Mr. Cushing is a past-chairman of the Boston Section of the A. I. E. E. and is widely known in the New England electrical field.

**T. Julian McGill** has resigned as manager of the Chicago office of the Westinghouse Electric & Manufacturing Company to become vice-president of the Twin City Rapid Transit Company of Minneapolis and St. Paul, in charge of operation and public policy. Mr. McGill was with the Westinghouse company since 1898, the preceding four years being spent with Augustine W. Wright, at that time vice-president and later president of the Siemens & Halske Company of America. In 1903 he was made the manager of the Minneapolis office. With Prof. C. F. Scott of Yale, Mr. McGill installed the Canyon Ferry-Butte transmission line, operating at 70,000 volts, which in those days was the highest transmission voltage in use in the United States. In 1909 he became manager of the Atlanta office, where he remained until 1914, when he was appointed to the managership of the Chicago office.

**Julian C. Smith,** vice-president of the Shawinigan Water & Power Company, was elected president of the Canadian Electrical Association at its annual convention last week. Mr. Smith was born in Elmira, N. Y., in 1878 and in 1900 was graduated from Cornell University with the degree of mechanical engineer. He began work with Wallace C. Johnson, consulting engineer at Niagara Falls, N. Y. Two years later he became assistant engineer to Mr. Johnson at Shawinigan Falls, Quebec. The following year he was made superintendent of the Shawinigan Water & Power Company, and in 1906 advanced to general superintendent, becoming in addition chief engineer in 1909. He also exercised supervision over the Cedars Rapids Manufacturing & Power Com-

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pany, which is operated by the same interests, and the Laurentide Power Company, which sells its output to the Shawinigan company. Mr. Smith has made many important contributions to technical literature and for two of his papers the Gzowski medal of the Canadian Society of Civil Engineers has been awarded to him—in 1913 for his paper on "Design of High-Voltage Transmission Lines," covering the new Shawinigan-Montreal lines, and again in 1917 for his part of a paper on the Cedars Rapids Manufacturing & Power Company's development. Mr. Smith is a fellow of the American Institute of Electrical Engineers and one of the small number of Canadians who are members of the British Institution of Electrical Engineers.

**R. W. Stanley,** who has been general manager in charge of production and engineering for Rauch & Lang, manufacturers of electric cars, Chicopee Falls, Mass., has been elected first vice-president.

**Frederic D. Brown,** for eight years manager of the Huron (S. D.) Light & Power Company, has resigned that position and will open an engineering office in Huron. He will undertake general engineering work, including consultation, estimates and appraisals.

**William H. Meadowcroft,** who recently celebrated forty years of association with Thomas A. Edison, was born in Manchester, England, May 29, 1853 and came to America in August, 1875. His first employment was as assistant chief clerk in the law office of Carter & Eaton. In the early part of 1881, when Major Eaton accepted an invitation from Mr. Edison to become vice-president and general manager of the Edison Electric Light Company, Mr. Meadowcroft entered the service of that company as Mr. Eaton's assistant. In the early eighties he wrote the first commercial paper ever published on the

W. H. MEADOWCROFT

incandescent electric light. During the years when he was connected with the Edison Electric Light Company he came into close association with many men now prominent in the electrical and business world. Among these were Samuel Insull, John W. Lieb, George F. Morrison, Charles L. Edgar, Schuyler S. Wheeler, Dr. Edward G. Acheson, H. M. Byllesby, John W. Howell, Wilson S. Howell, Frank J. Sprague, T. C. Martin, Frederick A. Scheffler, Miller F. Moore, Alfred O. Tate, William E. Gilmore, Rorbert T. Lozier and William J. Hammer. All of these men were pioneers in electrical work, and their names are indelibly engraved in the history of electric lighting. In 1885 Mr. Meadowcroft resigned from the company and with two friends formed a small organization to produce miniature incandescent lamps. This organization acted as authorized agents of the Edison Lamp Company. Two years later he rejoined the Edison company and subsequently became assistant to Francis R. Upton, manager of the Edison Lamp Works, Harrison, N. J. Some time later, owing to ill health, Mr. Meadowcroft took a leave of absence, returning as assistant to Major Eaton, general counsel of the Edison General Electric Company. A few years afterward he went back to the Edison Lamp Works at Harrison as secretary of the Edison miniature and decorative lamp department. This position he held for about seven years. On the discovery of X-rays by Roentgen, Mr. Meadowcroft induced the company to manufacture the Crookes X-ray tubes and apparatus and took charge of the X-ray department. Since then Mr. Meadowcroft has been interested in developments and experiments with liquid air. For two years he assisted Messrs. Dyer and Martin in the preparation of their biography of Mr. Edison. He is author of "The Boy's Life of Edison" and also of a primer entitled "A B C of Electricity," which has had a sale of more than 100,000 copies. In 1910 Mr. Meadowcroft was appointed assistant and confidential secretary to Mr. Edison, a position which he still holds. He is a founder member and the historian of the Edison Pioneers, an organization of men who were at one time associated with Thomas A. Edison.

**W. L. Goodwin,** assistant to the president of the Society for Electrical Development, was the guest of honor at a dinner given by the H. I. Sackett Electric Company at the Lafayette Hotel, Buffalo, on the evening of June 13.

**Herbert I. Markham,** who has been general manager of the Federal Sign System (Electric) and the Federal Electric Company, has resigned and has associated himself with Paul H. Davis & Company, investment bankers, and the Quaker Manufacturing Company, manufacturer of furnaces and ironing machines.

**Hoyt Catlin,** who since 1919 has been developing and selling heater switches and other specialties for the Bryant Electric Company, Bridgeport, Conn., has been appointed advertising manager of the company. For ten years Mr. Catlin was identified with the central-station branch of the electrical industry as assistant to the manager in the erection and operation of the gas-electric plant of the Ware County Light & Power Company at Waycross, Ga., and later as specialist on electric ranges for the Pacific Power & Light Company of Portland, Ore. In 1917 Landers, Frary & Clark of New Britain, Conn., engaged him to develop a line of electric ranges, but this work was necessarily delayed by the war. At the beginning of 1919 he became connected with the Bryant company.

**N. G. Symonds,** manager of the industrial division of the Chicago office of the Westinghouse Electric & Manufacturing Company, has been appointed manager of the Chicago office, succeeding T. Julian McGill, Mr. Symonds will have completed twenty years of service with the Westinghouse interests on Jan. 1, 1922. After his graduation from the Leland Stanford, Jr., University of California in 1901 as an electrical engineer, his first position was with a mining company in the Northwest. A short time later he joined the organization of the Westinghouse, Church, Kerr Company of New York in the stoker-erecting

N. G. SYMONDS

department. In January, 1903, he was made district superintendent of stoker erection, a position he held for two years. When the Westinghouse Machine Company became engaged in the manufacture of stokers Mr. Symonds went to East Pittsburgh as assistant engineer of that company's stoker department. In May, 1905, he was made stoker salesman for the Chicago office of the Westinghouse company. About 1915, when the Westinghouse Machine Company was absorbed by the Electric & Manufacturing company, he was made manager of the power department. In 1918 he was appointed manager of the industrial division of the Chicago office.

## Obituary

**Richard Hutchison,** formerly district sales manager of the Babcock & Wilcox Boiler Company, with offices at Boston, died recently at New Castle, N. B. He was born at New Castle in 1872 and was well known in New England engineering circles.

**Adolph Sorge, Jr.,** Western representative of the Harrison Safety Boiler Works-Cochrane Corporation, died on May 3. Mr. Sorge's work was confined largely to mechanical engineering. The Sorge-Cochrane hot-process water softener is a development of ideas originally patented by him. He was graduated from the Stevens Institute of Technology in 1875, and after various activities entered the steam engineering field in Chicago in the early nineties as superintendent of the foundry of the Fraser-Chalmers Company, builder of mining machinery and steam engines. In 1895 he became Western representative of the Harrison Safety Boiler Works, and he continued with that organization during its years of development and expansion into the present company.

# Trade and Market Conditions

**Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies**

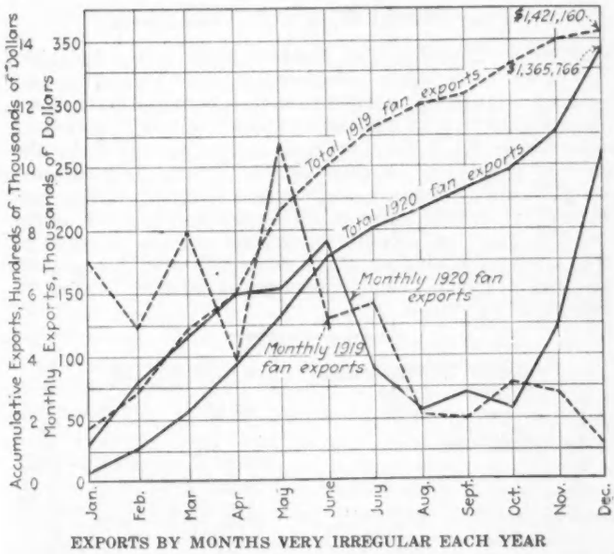
## Two Underlying Features for Better Business Conditions

THE second reduction in its discount rate, from 6½ to 6 per cent, has just been announced by the Federal Reserve Bank of New York, acting with the approval of the Federal Reserve Board at Washington. This rate of 6 per cent existed during the early months of 1920. This lowered rate does not directly create easy credit conditions but reflects such a condition and is a consequence of it.

Thomas W. Lamont, of J. P. Morgan & Company, has just returned from Paris, where he was financial and economic adviser to the American peace delegation. "Germany's acceptance of the reparation terms marked a pivotal point in the economic status of Europe," said Mr. Lamont, "and it is my belief that improvement will before long become manifest in the world's economic condition. For America there can be only one result of Germany's acceptance. It will mean in the long run stimulus to manufacture, better markets for our farm products and sound and increasing prosperity in both foreign and domestic trade."

## Analysis of Fan Exports for the Years 1920 and 1919

AN ANALYSIS of fan-motor export figures for the years 1920 and 1919 shows that while these exports in 1920 came to a total of $1,365,766, in 1919 they reached $1,421,160. There was no uniformity in the monthly reports during these two years. In 1920 the greatest value was exported in December, $257,432, followed by June and May, with January turning in the lowest amount, $29,587. In




EXPORTS BY MONTHS VERY IRREGULAR EACH YEAR

1919, however, May was the highest month, at $269,934, followed by March and January, December being lowest with $32,648.

British India took the greatest value in fans in both 1920 and 1919, but the other countries do not hold anything like the same sequence during those years. There were eleven countries importing American fans in 1920 in amounts over $25,000, while in 1919 there were ten countries. The Philippine Islands' total for 1919 was $43,418, but in 1920 its receipts of fans from the States amounted to only $6,787. The accompanying table shows clearly the relation of buying during the past two years.

Eleven countries in 1920, importing over $25,000 worth of American fans each, took $1,169,973 worth; these same countries imported $1,211,741 in 1919. Fifty-five countries in 1920, importing less than $25,000 worth of American fans, took $195,793 worth; the same countries in 1919 took $209,411 worth. The Eastern Hemisphere took the greater

1920 AND 1919 FAN EXPORTS

| | Value of 1920 Exports | Value of 1919 Exports |
|---|---|---|
| British India | $344,162 | $321,901 |
| Cuba | 192,292 | 49,064 |
| Argentina | 141,582 | 90,941 |
| Canada | 117,257 | 289,319 |
| China | 82,838 | 277,965 |
| Mexico | 68,808 | 51,466 |
| Spain | 68,246 | 11,638 |
| Hongkong | 55,001 | 77,949 |
| Japan | 47,852 | 22,661 |
| Uruguay | 26,105 | 4,982 |
| Brazil | 25,830 | 13,855 |
| Australia | 21,262 | 31,748 |
| England | 19,189 | 39,271 |
| Straits Settlements | 17,009 | 7,392 |
| Dutch East Indies | 14,623 | 14,319 |
| Panama | 13,213 | 8,931 |
| Philippine Islands | 6,787 | 43,418 |
| Forty-nine other countries importing fans | 103,710 | 64,340 |
| | $1,365,766 | $1,421,160 |

quantity of fans in both years, the figures of the seventeen countries tabulated for 1920 and 1919 being respectively $676,969 and $848,262. The corresponding figures for the Western Hemisphere are $585,087 and $508,588. Data have been compiled by the ELECTRICAL WORLD from figures given by the Bureau of Foreign and Domestic Commerce.

## Excellent Deliveries on Malleables

UNDER present conditions of demand delivery of malleable-iron products is only limited by the time required in manufacture. For standard-pattern items this would probably range in the neighborhood of one month. In view of the situation prevailing in the malleable market just one year ago it seems almost incredible that conditions could have exactly reversed in so short a time. Twelve months ago deliveries were anywhere up to a year behind, while at present operation in this field is only about 25 per cent of capacity and new business is very scarce. The automobile trade, one of the large consumers of malleables, has long been flat, but it shows some improvement now.

Prices have followed the pig-iron market down, but not nearly to so great an extent because of the labor factor. Valley furnace malleable pig, Pittsburgh, is worth $25 per ton delivered, a drop of more than 50 per cent from the peak. Prices on heavy malleables are estimated to be down from 20 to 25 per cent and more, but on light castings the drop has not been great, being only about 5 to 10 per cent. The reason for this difference is the increased unit cost on the small items due to handling, labor and other charges. Wages are down about 20 per cent, it is stated.

At the present time word has already gone out in the trade of a further reduction in the price of malleables to be made on July 1 amounting to 10 per cent. There seems little hope of this bringing about a stronger volume of buying, however, as the general expectation is that this year will remain quiet, with a gradually increasing demand toward the end of 1921.

## Bill Introduced Would Repeal Portable Lamp and Fan Tax

FOUR bills which amend the revenue law so as to relieve industry of $1,730,000,000 annually in taxation and transfer this to the owners of unused land and the inheritors of vast fortunes were introduced in Congress last week by Representative Oscar E. Keller of Minnesota. The bills are sponsored by the committee of manufacturers and merchants on federal taxation, of which Otto Cullman of Chicago is chairman, and which is said to have a membership of more than 31,000 substantial business firms in all parts of the United States.

The first bill repeals all existing transportation, stamp and sales taxes, with certain exceptions, and also repeals the excess profits tax and the 10 per cent tax on the income of corporations. The interesting feature of this projected measure for the electrical industry is that portable lamps and fan motors have been and still are included in "sales taxes."

The second bill amends the income tax so as to distinguish between earned and unearned income. The third bill amends the inheritance tax and the fourth bill provides for a land-value tax.

## A. M. E. S. Outlet Box Section Extends Its Scope

AT A MEETING of the Outlet Box Section of the Associated Manufacturers of Electrical Supplies held on June 7 at the Edgewater Beach Hotel, Chicago, it was voted, for the purpose of facilitating action of the various interested representatives in the Outlet Box Section, to enlarge its scope to embrace manufacturers of switch boxes, outlet-box fittings and cast boxes, the original sections to be divided into four sections by the addition of the new ones named. Only actual manufacturers of products involved will be eligible to the Outlet Box Section, it is understood, the term "manufacturers" to mean only companies who have invested in plant tools and machinery to produce the said products.

The officers of the Outlet Box Section are: G. H. Sicard, chairman, Pratt-Chuck Company, and H. G. Knoderer, secretary, Sprague Electric Works. R. P. Harrison, Thomas & Betts Company, was elected chairman of the Cast Box Section and H. G. Knoderer, secretary. Of the Outlet Box Fittings Section R. P. Harrison is chairman and C. Renshaw, National Metal Molding Company, is secretary. Of the Switch Box Section F. H. Merrill, Appleton Electric Company, is chairman and C. Renshaw is secretary.

## Increased Buying of Cross-Arms

WHETHER it is due to recent price decreases or not is uncertain, but producers report that buying of crossarms shows quite an increase of late. This increase in demand, it is stated, centers around central-station buying, the electric railway market being quiet. Demand is still far from normal, but producers are encouraged because it shows up as well as it does.

There may be some connection between current buying and the price situation, for on the first of this month a general cut on long-leaf yellow-pine cross-arms was made amounting to about 10 per cent. Fir cross-arms were not affected by the drop. This is not the first price decrease on cross-arms this year, as a cut amounting to 15 per cent was made on Feb. 1 and another varying from 9 to 15 per cent on March 1. These covered both fir and pine arms, and in addition fir arms went down about 10 per cent the middle of April.

Stocks are reported to be good with immediate shipments prevailing. Producers are optimistic that the market will open up considerably more during the latter months of the year.

Current prices on 75-per-cent-heart, long-leaf yellow-pine arms, quoted by a representative producer, are given below. The quotations include the recent cut above mentioned and are made f.o.b. Hattiesburg, Miss. Electric light arms, two-pin, 3 ft. x 3¼ in. x 4¼ in., less than 1,000 lineal ft., $28.61 per 100 net, over 1,000 lineal ft., $25.43; 6 ft. x 3¼ in. x 4¼ in., six-pin, less than 1,000 lineal ft., $57.23, over 1,000 lineal ft., $50.87; N. E. L. A. arms, 5 ft. 7 in. x 3½ in. x 4½ in., four-pin, less than 1,000 lineal ft., $64.72, over 1,000 lineal ft., $57.52; New England arms, 5 ft. 6 in. x 3¼ in. x 4¼ in., four-pin, less than 1,000 lineal ft., $57.23, over 1,000 lineal ft., $50.87. Quotations on the same size arms as above, in the same quantities f.o.b. cars Rutherford, N. J., on McCormick fir are as follows: $51.09, $45.41; $102.18, $90.83; $115.56, $102.72; $102.18, $90.83.

## Chicago Contractor-Dealers' Need for Building Up Stocks

THE announcement that Federal Judge Landis has consented to act as arbitrator in the dispute between the building trades and the contractors' association of Chicago and his action in insisting that building be resumed immediately pending a final settlement find Chicago contractor-dealers in a more favorable position than dealers in other building materials. While the local lumber, steel, brick and other building-material interests have been forced to keep their stocks close to normal on the chance that construction would be resumed at any moment, electrical contractor-dealers have been able to liquidate and cut down their supplies of various items and can now start to restock at the present favorable prices.

In general contractor-dealers have considerably reduced their supplies of such items as conduit, rubber-covered wire, sockets, fuses, knobs and tubes, plugs, switches, boxes, etc., while jobbers have plenty of this material on hand. This is an added instance of the fact that more often than not the jobber saves the dealer from some precarious situations and is an essential in any distribution system. Under present conditions local dealers can obtain almost any amount of supplies from jobbers within forty-eight hours.

Chicago building experts estimate the construction under way and planned for this season to be $100,000,000. Of this amount from $4,000,000 to $5,000,000 should go into wiring, fixtures, engines and generators. This schedule does not include the preliminary work being done on the Illinois Central Railroad electrification project.

## The Metal Market Situation

WITH continued lack of demand in the copper industry, prices have again weakened and are about ¼ cent lower on all positions compared with a fortnight ago. Some consumers have been induced by the low prices to purchase some copper for June, July and August and domestic demand is increasing. Foreign buying is very light and exchange rates continue in their recent decline. Large producers have quoted 13 cents per pound delivered for as far ahead as July, and small selling interests are reported to have accepted orders at 12.62½ cents delivered for prompt and June copper. The third-quarter position is held at 13 cents to 13.25 cents.

### NEW YORK METAL MARKET PRICE

| | June 14, 1921 | June 21, 1921 |
|---|---|---|
| Copper | | |
| London, standard spot | £ 73 7 6 | £ 70 7 6 |
| | Cents per Pound | Cents per Pound |
| Prime Lake | 13.00—13.25 | 12.75 —13.00 |
| Electrolytic | 13.00—13.12½ | 12.62½—13.00 |
| Casting | 12.00—12.25 | 11.75 —12.00 |
| Wire base | 15.00—15.25 | 15.00 —15.25 |
| Lead, trust price | 4.50 | 4.50 |
| Antimony | 5.12½ | 5.12½ |
| Nickel, Ingot | 41.00 | 41.00 |
| Sheet zinc, f.o.b. smelter | 10.00 | 10.00 |
| Zinc, spot | 4.95 | 4.95 |
| Tin | 29.37½ | 29.00 |
| Aluminum, 98 to 99 per cent | 28.00 | 28.00 |

### OLD METALS

| | Cents per Pound | Cents per Pound |
|---|---|---|
| Heavy copper and wire | 10.00—10.50 | 10.00—10.25 |
| Brass, heavy | 5.00— 5.25 | 4.75— 5.00 |
| Brass, light | 4.50— 4.75 | 4.00— 4.50 |
| Lead, heavy | 3.75— 3.90 | 3.50— 3.75 |
| Zinc, old scrap | 2.50— 2.75 | 2.50— 2.62½ |

# THE WEEK
## IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

TRADE in electrical materials continues to hold a quiet course, with little hope advanced of real activity before the fall months. Building of residences is keeping up at a fair rate in nearly all sections of the country. The Chicago deadlock has been broken and building has been resumed. Northern California, however, has not got back its activity in this line. Commercial and industrial construction is quiet.

Although general supply business is on a low level, heating devices are moving well in Chicago and hollow ware in the Intermountain and San Francisco districts. Washing machines keep up in Chicago, while in California ironers and dishwashers are moving well. Fan-motor sales have picked up all over. From the Southeast the reports of good crop yields, except cotton, open the way for better fall business, and in the Intermountain regions the crop outlook is better than for several years.

Though Boston reports New England collections a little easier to make, the other parts of the country hold that it is no easier to get in the money. Movement of wool in the Mountain States is providing a little relief there.

### NEW YORK

There is not a great deal of consistency to reports on trade this week; in several quarters a slight improvement is noted, but in others business shows no change. A large jobbing house finds that wire and motors from 5 hp. down are moving better. The general market is quiet, however. Plans filed for building work and contracts let recently show quite an increase, but there is apparently not much activity of this nature at a stage which aids the electrical market.

Armored cable boxes are down 15 per cent, the second reduction this year. Prices on conduit are being shaded, and in fact there is very little material on which prices are not lowered on occasion to meet competition. Fan buying has shown its first signs of life but is not generally good. Vacation sales of flashlights have been disappointing. Schedule material is moving a little better, but rather because the trade is again replacing stock following the recent price decrease. Thirty days' supply of goods is about the most that any jobber is carrying, while the stocks of a good many are considerably under this.

**Armored Cable Boxes.**—Effective June 20, manufacturers of armored cable ceiling boxes reduced prices 2½ cents per box in standard-package quantities to jobber. This amounts to about 15 per cent and follows a cut of 25 per cent made earlier this year.

**Conduit.**—Fairly good stocks are held, but very little is moving. In 2,500-ft. lots ½-in. black is quoted at $62 to $65.28; galvanized, $66.86 to $70.38; 1-in. black, $116 to $123.75; galvanized, $125.65 to $134. These prices are being shaded at present.

**Non-Metallic Flexible Conduit.**—Little or none of this material is moving and stocks are spotty. In 1,000-ft. lots ⅜-in. brings $22 to $23.10 and ¼-in. from $24 to $25.15.

**Lamp Cord.**—Good stocks are held, but these are not moving. No. 18 cotton-twisted in 1,000-ft. lots sells for $13.75 to $17.70 and parallel from $16.50 to $18.75.

**Tape.**—Demand is spotty and on the whole is far from good. The supply is plentiful and in 100-lb. lots brings all the way from 38 and 37 cents per pound on friction and rubber tape respectively to a high range of 52 cents on both. The average price, however, varies from 40 to 45 cents.

**Fuses.**—Price reductions have not helped stimulate the present fair demand much. In standard-package quantities jobbers quote N. E. C. standard non-renewable 30-amp. fuses at $7.50 to $11 per 100, and 30-amp. renewable fuses listing at 50 cents each, 40 to 42 per cent off list.

**Safety Switches.**—Several jobbers say demand has picked up materially and is fairly good at present but others do not confirm this, especially on switches for industrial use. The growing favor of the meter switch used extensively in New Jersey has undoubtedly helped sales of this type. Prices are steady for the time being.

**Flashlights.**—There has been a small vacation demand but nothing great as yet. Renewal business is only average. In standard packages 40 and 10 per cent is allowed.

**Fans.**—Within the last week or two fans have started to move and a number of jobbers report good sales, but the general situation is not what it should be as several houses have not yet really begun to sell. The most popular size is the 16-in. oscillator.

### CHICAGO

In the construction labor controversy both sides presented arguments to the arbitrator, Federal Judge Landis, this week. Work has been resumed on all jobs which were under way when the shutdown came, probably 20,000 men returning to work. This has put some life into sales of construction supplies, but no new work is being initiated pending the arbitrator's decision, which, it is stated, will probably not be made until the end of this week. A disturbing feature is the failure of the carpenters' unions to agree to abide by the result of the arbitration. Many of them have refused to return to work and as a result the progress of work under way is being seriously retarded.

Trade conditions remain quiet, prices in most lines remaining unchanged and orders being limited to actual requirements.

Ninety days remain the average for collections in the jobbing trade, no real improvement having been noted. Money stringency continues, both in the farming districts and in the manufacturing towns, particularly in such cities as devote most of their activity to one particular line. Collections in the city of Chicago still remain better than in the country.

**Heating Appliances.**—Former prices still prevail and the usual rush of wedding trade has caused a real flurry in demand. Some jobbers report stocks, not large to begin with, as exhausted. The demand is not playing any favorite, everything from a flatiron at $7.75 up to nine-cup percolator at $25 moving with equal celerity. The advent of extreme hot weather is helping the market.

**Fans.**—Midsummer temperature prevailing in June has helped distribution of fans, particularly for household use. Normal demand is sufficient to keep stock moving without any special price inducement. A peculiarity of the trade is that while marked economy is noted on the part of the retail buyer in practically all lines, the better types of fans are having first call.

**Washing Machines.**—This line continues to be the backbone of the retail business and seems in better shape than any other all along the line from the manufacturer down to the retailer. Factory activity is remaining about constant at the pace set in April, and sales effort backed by the proper financial arrangement meets unfailing response.

**Line Hardware.**—A reduction of 5 per cent on all line hardware has just gone into effect. Business is quiet, being limited to maintenance requirements almost exclusively. The apparent probability of a cut in steel prices in the near future discourages any heavy buying.

**Wire.**—All quotations are unchanged. Market for outside wire is very limited, greatest activity being noted in bare copper for replacement. A slight increase in demand for inside wire is noted in the city, due to resumption of building work, but buying is very cautious.

## BOSTON

No marked change is apparent in trade this week, although the general trend is upward in volume. Jobbers' stocks in many lines are now considerably reduced, and on some makes of domestic labor-saving equipment deliveries are running up to three or four weeks. Collections are a trifle better, and one large house reports that its leading accounts are being liquidated to better advantage. Seasonal appliances are rather dull and power equipment is moving very slowly. Building and engineering contracts for the week ended June 14 totaled in New England $3,329,300, according to the published Dodge reports. This represents a low volume compared with corresponding weeks of war-time years except 1918, which it exceeds by half a million dollars. Labor conditions in the electrical field are relatively quiet this week. Central-station output is very well maintained considering the general business situation.

**Motors.**—Light buying of small motors in single lots is reported, with increased sales to diversified industries. This business is far below normal, but appears to have turned the corner toward better demand.

**Flatirons.**—Vigorous sales campaigns are moving flatirons fairly well. On some lines deliveries are being met by subdividing shipments. Prices are unsteady on the older designs, which are being offered at mark-down sales in retail circles. In a three weeks' campaign just closed the Central Maine Power Company sold 1,641 irons against a quota of 1,505, yielding about $8,000. The latter designs are firmer in price.

**Rubber-Covered Wire.**—A moderate demand is reported, with good stocks. Single-braid No. 14 is moving at $7.50 per 1,000 ft. net in lots of 1,000 ft., $6.50 in 5,000-ft. lots, and on application above this. Central-station expansion is slow and new house wiring is not normally active. One suburban central station near Boston will obtain, however, about $30,000 worth of house-wiring contracts in a six weeks' campaign now concluding.

**Flexible Armored Conductor.**—Prices are weak in quantity sales. This material is moving fairly well at present, and in lots of 1,000 ft. $55 per 1,000 ft. is being obtained on single-strip or double-strip No. 14.

**Non-Metallic Flexible Conduit.**—Small quantities are being handled in this territory with no complaint as to supply. The demand is somewhat spotty. Prices are softer, ½-in. selling at $22.50 per 1,000 ft. in 1,000-ft. lots and at $30 per 1,000 ft. in lots of 250 ft. The $\frac{7}{32}$-in. size sells respectively as to quantity at $20 and $25 per 1,000 ft.

**Ironers.**—Considerable interest is developing in this equipment. An active retailer complained Monday that stocks are too low in some cases to enable him to close immediate sales.

**"Nail-it" Knobs.**—Although the demand is not heavy, some sales are going through from existing stocks. Present prices in barrel lots and three-barrel lots are $21 and $18 per 1,000 respectively.

**Iron Conduit.**—The market is not very active, but some pipe is moving into the hands of contractors doing construction work. Typical net prices per 1,000 ft. are as follows in less than 2,500-lb. lots; ½-in., black $62.18, galvanized $67.28; ¾-in., black $80.67, galvanized $87.57.

**Push Switches and Plates.**—The latest prices on this equipment are given below, current demand being moderate only, standard packages: single-pole, 27 cents; three-way, 38 cents; one gang, 11 cents; two gang, 22 cents; three-gang, 33 cents.

## ATLANTA

This week gives indication that business so far for the month of June in the electrical jobbing trade is considerably improved over the May average, one or two of the firms reporting an increase of as much as 30 per cent in the volume of business done. Conditions in the rural districts continue slow, though Florida activities continue to hold up unusually well. This in a measure is a reflection from an excellent citrus crop and tourist patronage. Crop reports from various Southern states indicate excellent conditions in agricultural lines, virtually all crops being in very good shape for this time of the year, with the exception of cotton. Among these is the report from Louisiana that the rice sales are already 2,500,000 pockets ahead of last year, with the European demand very firm. These conditions will not serve to assist business in general until early fall, when the farming population is able to market its products and thus liquidate outstanding obligations.

**Porcelain.**—A general price reduction in all lines of porcelain, ranging from 5 per cent to 8 per cent, became effective this week, but has not served as yet to cause any activity above that of the past few weeks. Stocks are dull and heavy.

**Fans.**—The continued hot spell is assisting in a brisk movement of fans, though the volume of business this year will not equal that of last. Ceiling fans are moving very satisfactorily. In the case of desk fans it is to be noted that purchasers are buying smaller-size fans this year than heretofore.

**Ventilating Equipment.**—Hand-to-mouth purchases are still the rule as jobbers and dealers could not anticipate what this specialty would do. Orders are coming in very satisfactorily, however, in spite of the necessity for a large proportion of factory shipments because of spotty stocks. The demand seems to be strongest for the 24-in. size.

**Twin Plugs.**—Jobbers and retailers report rapid sales. An 8 per cent price reduction was offered last week.

**Sewing Machines.**—In the territory as a whole these are moving very slowly, but special campaigns have served to sell a very fair quantity in Atlanta and vicinity. All jobbers report heavy stocks.

**Interphones.**—The demand can be reported as only fair, the tendency of builders being to eliminate all items of expense, with the result that this specialty has not kept pace with other lines of building material. Local stocks are reported as quite heavy.

**Wire.**—Rubber-covered continues on a 15-cent base in the face of a very weak market. The price is not stabilized on sizes up to No. 14, there being a variation of around 50 cents per 1,000 ft. Weatherproof continues to hold up fairly well in the more popular sizes of No. 6 to No. 12 and is steady on a 16-cent base.

**Flexible Armored Conductor.**—This occupies a rather peculiar position at the present time, the quotations being offered showing little or no stability owing to a very spotty demand and heavy stocks. The average quotation is on the basis of $69 per 1,000 ft., though recent quotations show a variation of as much as $10 per 1,000 ft. from that figure.

## ST. LOUIS

Business conditions in this territory seem to be approaching a certain level where but little weekly change can be noted in demand or production. This level, while materially higher than that prevailing at the first of the year, is nevertheless in most lines far from normal. No appreciable betterment in business conditions is now expected before fall, and some express the possibility that it may not come until spring. However, it cannot be denied that the foundations of the business structure in this locality are becoming stronger; credit is more substantial, stocks are everywhere reduced to the minimum, giving higher turnover; demand for essential commodities is increasing, and conservatism marks all business developments. The same conditions are found in the electrical jobbing and merchandising lines. A good volume of business is found, but it is reported that the profits therefrom are meager owing to the continued necessity of revising inventory valuations downward.

**Schedule Materials.**—A reduction of six points in the discounts on all schedule materials is announced. Stocks are rather heavy in all items and the demand is considered slow.

**Knobs and Tubes.**—Very light movement is encountered because of the small amount of new construction work. Some increase is noted as residential building increases. Stocks are about in line with the demand. "Nail-it" knobs are quoted by a large jobber at $19.80 per 1,000 in barrel lots. Three-inch tubes are quoted at $8.30 per 1,000.

**Fuses.**—Steady demand in almost all sizes and kinds is experienced. Stocks are maintained on a conservative basis. In standard package lots the prices on N. E. C. 220-volt cartridge fuses are quoted by a representative jobber as: 10 amp., 13½ cents each; 30 amp., 13½ cents; 60 amp., 17½ cents. Other quotations run lower; for example, one quotation of 10 cents is found on the 30-amp. size. The 30-amp. renewables are quoted at about 29 cents each in standard packages.

**Conduit.**—A representative price for ½-in. black is $66.10 per 1,000 ft. and for 1-in. black $123.70 per 1,000 ft., both in 5,000-ft. lots. These prices are about 5 per cent lower than those quoted a few weeks ago by the same jobber. In the expectancy of lower prices stocks have been kept at a minimum by most jobbers for some time. A small increase in demand is reported.

**Wire.**—A fairly good demand for the smaller sizes of rubber-covered held throughout the week, and there is a slight tendency toward increased demand on weatherproof. Some purchasing by the jobbers from manufacturers is found, but as a rule just enough to maintain satisfactory stocks. The price on No. 14 rubber-covered remains around $6.75 per 1,000 ft.

**Safety Switches.**—One line of switches has been reduced about 5 per cent in price in certain kinds. Other reductions would not be unexpected. The volume of sales is rather low. Stocks appear to be everywhere in line, and consequently jobbers have been firm in their prices.

**Fans.**—Continued warm weather has maintained good wholesale and retail movement the past week. The indications are that the year will be a very successful one in this line. Replacements in stocks are being closely watched to avoid the possibility of carrying over any large amount of stock until next year.

## SAN FRANCISCO

The builders' strike, from which the present electricians' lockout is an outgrowth, seems to be progressing toward an eventual settlement. A comparatively few of the electrical contractors are operating full staffs on the open-shop plan; there is plenty of work in sight for them. The larger jobs are still held in abeyance, although union leaders instructed the men that, beginning June 20, there would be no objection to their signing for work on jobs where the open shop prevailed. It is felt that the situation is now reaching its crux and that next week's developments will prove a determining factor.

The contracting business of northern California is virtually at a standstill, and the appliance business has slackened noticeably, but the power companies are still providing excellent business in pole-line materials. Another source of good business is the government, all of whose yards are operating at top speed. The extensive military plant of the government at the Presidio, San Francisco, is congested not only because of the removal thither of the Western Corps' headquarters staff but also because of the constantly increasing military and naval activity along the Pacific Coast.

Credits and collections are below normal and some jobbers report a very lax interpretation by their customers of the cash discount.

**Household Appliances.**—The customary June wedding sales were reflected in a better movement of household appliances, particularly of the percolators and smaller hollow ware. Most dealers, in expecting the drop in list prices of flatirons and small heating devices, have been buying in negligible quantities. Of the larger appliances for household service ironers and dishwashers are showing a movement beyond all proportion to the better-known clothes washers and vacuum cleaners. They are being displayed well and in nearly every case are being demonstrated in the stores. Sewing machines have picked up.

**Marine Material.**—The seamen's strike, which has filled Pacific Coast harbors with idle ships, has dropped marine wiring to a small fraction of its normal volume.

**Radio Material.**—Probably the best-selling retail line at the present time is that of wireless material. More and more dealers are carrying complete stocks and are improving their sales facilities by the installation of wireless departments and wireless demonstrating and sample rooms where amateur operators, who furnish the bulk of the present business, may drop in for information and practical suggestions. Daily wireless demonstrations are made in the larger stores.

## SALT LAKE CITY—DENVER

The outlook for big crop yields in the Intermountain region has not been brighter in a number of years. Though farmers are hard put to it for additional labor during the period of planting, there has been little reduction of acreages of the various kinds of crops. The recent disposal of wool has brought some money into the banks but not in sufficient amounts to relieve entirely the tense credit situation. Collections are reported to be about as slow as ever. The building of homes is proceeding at a fairly good rate in the larger cities. Jobbers are plentifully stocked with all electrical materials called for by contractors and can make deliveries on demand. Labor conditions are good.

**Motors.**—Dealers, especially those maintaining service stations, report a large demand for motors of the size that are used principally for replacement on washing machines and sewing machines.

**Hollow Ware.**—With the advent of hotter weather and the consequent increased use of chafing dishes, toasters and percolators, trade in hollow ware is showing a marked improvement.

**Flashlamps.**—Business in this line is particularly good at present, the impetus in demand coming from their increased use during the touring season. The price is stable.

**Flatirons.**—Some dealers are stimulating business by offering a trade-in proposition on used irons. The regular demand, however, is small, and the price is regarded as the biggest bar to general buying.

## SEATTLE—PORTLAND

Neither jobbers nor dealers in Seattle and the Puget Sound district report any change over several weeks past, and they assert that June business will be as light as or lighter than that of the preceding month. In spite of increased efforts to increase sales volume, sales of house-wiring devices, schedule material and domestic appliances, while not dropping off, are far below original expectations. There are frequent drops in prices on certain lines, particularly cord, switches, schedule materials, etc. These decreases, while not large, have an effect on jobbers with large stocks. Domestic appliance prices are holding up and are not expected to drop until fall, if then. Collections are no better and no worse. It is believed there will be a considerable number of failures of small-appliance dealers and contracting firms in this district before and during fall months unless conditions change radically.

Residential construction is still showing improvement. The larger class of construction, however, is being held up more or less because of improper financing and in many cases the lack of any. In western Oregon and Washington 114 lumber mills report last week's production at 57,700,000 ft., which is 30 per cent below normal. The mills and camps are expected to close down for a week or two early in July, and during this time many will make repairs and betterments. The non-employment situation is still far from a solution as there are about 6,000 idle men in Seattle alone.

Portland jobbers report business improving somewhat, but the change is very slight. There is some activity, however, in line construction material. There has been no warm weather in this section of sufficient duration to develop any activity in fan sales. The credit situation is in very poor shape; collections are not materially better than they have been, the average for Portland being about forty-six days outstanding. The average is kept down as low as this primarily by the promptness of large accounts as the majority of the smaller accounts, particularly contractors', dealers' and lumber companies', are on a very much longer time basis. Portland contractors report considerable activity in residence wiring and general remodeling work. Fixtures are active, owing largely to activity in residence building.

# Manufacturers' Activities

**Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature**

## Revised Schedule of A. M. E. S. Meetings and Events

In the final revised schedule of meetings of the summer sessions of the Associated Manufacturers of Electrical Supplies, June 27-30, at the Hotel Griswold, New London, Conn., a few changes are noted from the schedule published on page 1385 of the ELECTRICAL WORLD for June 11. Of the four meetings formerly set down for Thursday, June 30, the Fuse Section will meet on Tuesday and the Knife Switch, Molded or Formed Insulation and Line Material Sections will meet on Wednesday. Thursday is open for matters demanding further consideration.

The dinner-dance, entertainment and radio demonstration will take place Tuesday evening. Three handicap golf matches are scheduled for Monday and Tuesday.

From the returns received up to the middle of this week the summer meetings will establish a record for attendance and interest. The interest in the association has increased greatly this spring, for whereas at the first of the year the company membership totaled 190, the present company membership is 225. The association started in 1915 with eighty-three members. Former members who have withdrawn are coming back in considerable numbers.

## A. H. Petersen Company Discontinues Tool and Die Department

The A. H. Petersen Manfacturing Company, Milwaukee, manufacturer of tools and dies, etc., announces that it has discontinued this department and will turn over its entire plant to the manufacture of "Hole Shooter" portable electric drills and other automotive devices.

## Frigidaire Consolidated with Delco Light Company

Announcement was made on June 18 by the General Motors Corporation, Detroit, Mich., that the Frigidaire Corporation has been consolidated with the Delco Light Company, the two latter companies being subsidiaries of the former. No information has yet been received as to whether or not the manufacturing of Frigidaire equipment will be moved from Detroit to Dayton.

For some time sales of Frigidaire machines have been conducted through the sales organization of the Delco company, but now there is a physical merger of the two companies. R. H. Grant, general manager of the Delco Light Company, will be general manager of the consolidated companies, while J. Parker Fiske has resigned as president and general manager of the Frigidaire Corporation.

## Better Business in Wire Reported by Belden

The Belden Manufacturing Company, Chicago, Ill., according to C. P. Belden, is finding that the demand for rubber-covered wire and for lamp cord has picked up within the last forty-five days. Mr. Belden states that orders for rubber-covered wire have been slightly ahead of production, while appliance manufacturers are placing orders for lamp cord that are generous under existing conditions. The market for magnet wire has fallen off. Most of the larger users of this product are still heavily stocked up. Considerable business is being placed for repair purposes.

## Western Electric Dedicates Athletic Field to Veterans

To honor the memory of the forty-nine Western Electric men who died in the war the company has just presented to its employees a completely equipped 10-acre athletic field at Hawthorne, near Chicago, between Twenty-second and Twenty-third Streets and Forty-ninth and Fiftieth Avenues. H. F. Albright, vice-president of the Western Electric Company and superintendent of the Hawthorne Works, in making the presentation, explained the part athletics play in supplying a big industry's people with the chance to get acquainted and to develop group spirit. He attributed the splendid spirit existing in the ranks of the company to the great share outdoor exercises have had in its welfare programs.

The grounds include an eight-lap track, space for basketball, baseball, soccer, lacrosse, etc., twenty-two tennis courts and provision for flooding fields to make ice for winter sports.

## J. F. Davis Enters Boiler Manufacturing Field

After thirty years of experience in manufacturing, engineering, dealing and selling in connection with every phase of the power boiler industry, J. F. Davis has organized the J. F. Davis & Sons Company, with a capitalization of $500,000, and articles of incorporation have been issued. J. F. Davis is president and treasurer and his son, J. E. Davis, is secretary. General offices will be established in the Harris Building, Chicago.

The company has purchased the entire plant site, machinery and equipment of the De Pere Manufacturing Company, West De Pere, Wis., where facilities are adequate for both rail and water shipment. Boilers, tanks and special steel-plate construction and fabrication will be a part of the work. In addition the company plans to continue reconditioning used boilers. Mr. Davis has been especially active in salvaging and marketing power plants of various war industries, and in both this country and in Europe these boilers have again been put in operation.

A water-tube boiler of special design is contemplated with a view to obtaining better efficiency of operation, but until present tests are completed it is being withheld from the market.

## Olson-Boettger Electric Reorganizes and Undertakes Jobbing

The Olson-Boettger Electric Manufacturing Company, St. Paul, Minn., announces its entrance into the electrical jobbing field and its reorganization under the name Olson-Boettger Electric Company, with an increase in capital stock of $75,000 to $250,000. H. S. Olson is the president and treasurer, J. O. Nelson secretary, and R. P. Young vice-president and manager.

The corporation will conduct its jobbing business from its modern five-story building at 108 East Third Street, St. Paul, while its old location at 413 North Franklin Street will be used for a repair shop for rebuilding motors and generators. Seven men will cover Minnesota, North and South Dakota and part of Iowa and Wisconsin.

## Increase in Representation by E. O. McDonald

E. O. McDonald, manufacturers' representative in wiring devices at 30 Church Street, New York City, has taken on the line of sectional switch boxes manufactured by the Mansfield (Ohio) Electric Hardware Company for the metropolitan district and New England.

## Triumph Electric Announces the Removal of Three Offices

The triumph Electric Company, Cincinnati, manufacturer of motors and generators, announces the removal of its Chicago office from 628 West Lake Street to 2814-16 Wentworth Avenue, where it has more spacious quarters. W. R. Bonham is manager of this office. The company has also moved its New York office, of which T. W. Kloman is manager, from 80 Cortlandt Street to the Knickerbocker Building, Forty-second Street and Broadway. The Wood & Lane Company, St. Louis representative of the company, is now established at 1016 Market Street, St. Louis, where it has large warehouse facilities and carries ample stocks of the various lines.

## New Officers for Stoker Manufacturers' Association

At the annual meeting of the Stoker Manufacturers' Association, held in Stockbridge, Mass., June 14 to 16, the following officers were elected: President, Maxwell Alpern, vice-president American Engineering Company, Philadelphia; vice-president, S. A. Armstrong, vice-president Underfeed Stoker Company of America, Detroit; treasurer, Richard D. Hatton, vice-president Laclede-Christy Co., St. Louis; secretary, J. G. Worker, vice-president Phoenix Manufacturing Company, Eau Claire, Wis. These officers, with the addition of R. Sanford Riley, retiring president, and A. G. Pratt of Babcock & Wilcox Company, make up the executive committee.

In discussing the advertising and publicity requirements of a typical stoker company, H. E. Cleland pointed out the necessity of selecting mediums with special care and then advertising consistently. It was decided not to extend the scope of the association at this time to include membership of semi-automatic shaking-grate manufacturers.

Golf matches took up the attention of the attending members every afternoon, and the award of prizes was made a special feature at the banquet on Wednesday evening.

## Laundryette's Plan to Get Consumers' Viewpoint

Believing that a satisfied customer is the best advertisement, the Laundryette Manufacturing Company, 1190 East 152d Street, Cleveland, is in the midst of a six weeks' drive called a "User's Book Contest." The competition is taking place among Laundryette distributers and dealers and their salesmen, and it is the idea to see who can build the best scrapbook containing from ten to fifteen original letters from users of the company's washer and dryer. Prizes, of course, will be awarded to the winner and for certain runners up.

## National Metal Molding's Plan to Extend Existing Wiring

Under the slogan, "Brings Electricity Where Needed," the National Metal Molding Company, Pittsburgh, is putting on an extensive advertising campaign to extend existing wiring by putting in more outlets while keeping the conductors concealed.

The objects in view are to create a desire for making the fullest use of electric service, to point out the advantages of adequate wiring and to educate and interest the public in the company's product. If the plan is successful in one of its chief objects, namely, to assist the company's distributers and electrical contractors in making sales and installations of National metal molding, it must be conceded that it will bring with it the market for other electrical wiring devices and appliances.

Through the use of the *Saturday Evening Post* as a national medium to reach a consumer market the company is tying in its trade paper advertising and local advertising with dealer and sales help. Without aggressive sales work, however, it is felt that the plan will lack success.

## New Recreation Grounds for Electric Storage Battery

The Electric Storage Battery Company, Philadelphia, is about ready to turn over to its employees a modern and completely equipped club house and recreation ground, including baseball field, tennis courts, bowling alley, shooting gallery, pool and billiard tables, gymnasium apparatus, shower rooms and dining room, etc. An interesting provision in this turnover is that the employees themselves assume entire charge and responsibility for the clubhouse and grounds, including the cost of maintenance. To date the enrollment takes in more than 1,500 of the members.

## Electric Hoist Manufacturers in Publicity Field

Two recent bits of publication from the Electric Hoist Manufacturers' Association, 165 Broadway, New York City, embody the slogan—"The Strong Arm of Industry." One of these bulletins, "Approved Applications," pictures and describes under 133 headings partial uses to which electric hoists have been applied, while the other one, "Monorail Runway Construction," gives specifications covering standard practice in monorail runway construction, including curves and tables.

## American Di-Electrics Sees Big Market for Insulation Ahead

American Di-Electrics, Ltd., 71 West Broadway, New York City, which has been in the field of electrical insulation as manufacturer and engineer for about a year, reports that business, though small individually, is constantly on the increase. John H. Barker, president and general manager of the company, attributes this to the natural growth of a newcomer in a large field. He is extremely optimistic over the business outlook in this line, because with everything electrical in the country gradually wearing out and comparatively little repair work being done, there should be an enormous potential market. This, he thinks, will make itself felt by fall.

## Risler & Hornung, Inc., Jobbers, Formed in New York

Risler & Hornung, Inc., a new addition to the electrical jobbing trade in New York City, has opened offices on the ground floor of 132 West Thirtieth street. The company will handle the usual line of electrical supply items and appliances, selling goods at wholesale only. Among the manufacturers whose goods are carried in stock at present are the "Apex" cleaner, "Locomotive" washing machine, the "Star" and the "Peerless" motors and the "Monarch" renewable fuse. E. A. Risler, Jr., formerly owner of the Fullerton Electric Corporation, supply jobbers at Scranton, Pa., is president. Mr. Risler for the past two years has been sales manager and secretary of the F. W. L. Fullerton Company, supply jobber, New York City. H. J. Hornung, secretary and treasurer of the new company, was until April 1 of this year manager of the Western Electric Company's Fortieth street branch office, New York City.

## Indemnity Company Handles Motor Insurance

The Royal Indemnity Company, 84 William Street, New York City, after having worked for some months on a form of policy for the insurance of electric motors, etc., early this year received approval from the insurance authorities in New York State of the form of a policy which would indemnify for the electrical and mechanical breakdown of motors, generators, transformers, regulators and other electrical apparatus. The company guarantees the repair bills directly incidental to such troubles.

In the opinion of the Indemnity company manufacturers will probably find a reduction in numbers of complaints from alleged defects in workmanship and material, since actual causes of breakdown will be determined by the guarantor's field force and the findings will usually fail to show defects traceable to the manufacturer. Up to date most of the insurance written seems to be in Canada and in the Western and Far Western States, and a good part of it is applied on electrically driven pumps for irrigation purposes.

## Greenfield Tap & Die Absorbs Two Grinder Companies

At a meeting of the board of directors of the Greenfield Tap & Die Corporation held Thursday, June 9, it was voted to purchase the entire capital stock of the Greenfield Machine Company of Greenfield, Mass., manufacturers of cylindrical and universal grinders, and the Morgan Grinder Company of Worcester, Mass., manufacturers of internal grinders.

The combination of the Morgan Grinder Company and the Greenfield Machine Company, together with the machine business now conducted by the Greenfield Tap & Die Corporation, will constitute the machine division of the Greenfield Tap & Die Corporation.

The Greenfield Tap & Die Corporation will operate both plants in their present location, although eventually the Worcester plant will be moved to Greenfield. The organization of both plants will remain the same.

**The Banks Supply Company**, Huntington, W. Va., electrical supplies, has taken on the line of "Denzar" fixtures of the Beardslee Chandelier Manufacturing Company, Chicago. A complete stock is on hand.

## Foreign Trade Notes

PROPOSED ELECTRIC PLANT FOR CHINESE RAILWAY. — The Tientsin-Pukow Railway Company, according to *Electrical Industries*, has decided to build an electric plant at Pukow, to cost about $900,000.

THE ONWARD MANUFACTURING COMPANY, Kitchener, Ontario, has made arrangements with Blackadar & Stevens, Roy Building, Halifax, N. S., to act as its wholesale distributer for the Eureka vacuum cleaner for the Maritime Provinces, which include New Brunswick, Novo Scotia and Prince Edward Island. The company has also engaged the Weber Sales Company, 862 Cambie Street, Vancouver, to act as its distributer for the Province of British Columbia.

NAMES OF AMERICAN BUSINESS REPRESENTATIVES IN EGYPT DESIRED.—Julian E. Gillespie, assistant trade commissioner, writes from Constantinople that the American Chamber of Commerce of Egypt, at Alexandria, desires to obtain the names and addresses of all agents of American manufacturers and exporters in Egypt. This information should be sent to the secretary of the above-named institution.

FRENCH SENATE HAS VOTED CREDITS FOR THE PROPOSED RHONE POWER SCHEME.—The French Senate, according to *Electrical Industries*, has voted the necessary credits for the proposed scheme for developing the water power of the Rhone and has approved the details of the plan for making the river a navigable waterway, a source of great hydraulic power and a means of irrigation. The plans provide for not less than eighteen power stations to be erected along the course of the river, the largest of which will be at Genissat, near Belegar, which will have a generating capacity of 200,000 kw. The total output of all the stations is estimated at about 1,100,000 hp. The two most important consumers of this energy will be the P. L. M. Railway Company and the city of Paris. The railway company plans to equip all of its lines included in the quadrilateral bounded by Belegar, Lyons, Marseilles and Vintimille for electrical operation. The distance between Paris and Genissat, the station which is to supply electricity in Paris, is 280 miles. Energy will be transmitted to Paris by two great feeders, one passing through Dijon and the other through Nevers, the two being linked up just before they reach Paris. Each of these feeders will consist of six cables, which will transmit 150,000 volts. The cost of this installation is estimated at about 60,000,000 francs.

SURVEYS FOR HYDRO-ELECTRIC PROJECTS IN INDIA. — Several surveys have been undertaken by the Assam government, according to *Electrical Industries*, for a hydro-electric development. The Hukong Valley scheme seems to be the most promising.

BRUSH ELECTRICAL CLOSED SUCCESSFUL YEAR.—From the report of manufacturing operations for the year 1920 submitted at the thirty second general meeting of the Brush Electrical Engineering Company, Ltd., London, held May 9, it appears that the company had a prosperous year. After providing for all general charges, maintenance of plant and buildings and interest on the company's debenture stock and loan, there is a balance of profit of £191,096. After writing off depreciation, expenses in connection with the issue of capital last year, and other certain expenses there is carried forward an amount of £143,268, as a result of the year's operation. The gross profit on trading was £285,328 as compared with £223,000 in the preceding year. Expenses, of course, were higher. The report states that the company's order books are well filled and there has been a gratifying increase in the demand for its Brush-Ljungstrom turbo-generator plant. Orders on hand at the time of the meeting represented in horsepower more than the total the company supplied in the whole period from the commencement of the manufacture of this generator in 1914 to the end of 1920. A new factory now under construction at the Falcon Works is to be devoted to the manufacture of this turbo-generator. The position of the company has improved with regard to the giving of quotations on long-time contract, and the company is now able, the report states, to make contracts at firm prices. The export trade situation is reported far from satisfactory with the result that the nation is already suffering heavily by loss of much of its foreign business.

THE DEVOE ELECTRIC SWITCH COMPANY, 414 Notre Dame West, Montreal, has established an office and showroom at 105 Victoria Street, Toronto, in charge of W. R. S. Careless.

## Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm of electrical merchants in Spain (No. 35,049) desires to obtain the representation of manufacturers of miscellaneous electrical appliances and household conveniences such as fans, flatirons, warming pads, sweepers, toasters, grills, percolators and heaters.

A manufacturer in Italy (No. 35,052) desires to purchase machinery for the manufacture of 30,000 glass bulbs per day for making incandescent lamps.

A merchant in India (No. 35,025) desires to purchase electrical goods and appliances such as bulbs, shades, lamps and fans.

## New Apparatus and Publications

GAS-PURIFYING EQUIPMENT.—Chas. Eisler Engineering Company, 15 Kirk Place, Newark, N. J., is now marketing electric high-pressure nitrogen and argon gas-purifying equipment which is adaptable for filling type "C" lamps and for laboratory purposes.

ELECTRIC VEHICLE. — The Walter Motor Truck Company, 227 West Sixty-first Street, New York City, has developed a new line of electric road truck of from 1500-lb. to 7-ton capacity.

LIGHTNING ARRESTERS. — The Hi-Voltage Equipment Company, Cleveland, has developed a new type of lighting arrestor for outdoor mounting.

FLATIRON.—A new 3-lb. electric flatiron with curling-iron attachment has been placed on the market by Manning, Bowman & Company, Meriden, Conn.

LIGHTING FIXTURES. — The Polly Manufacturing Company, Polacheck Building, Milwaukee, Wis., has issued a forty-eight-page catalog covering its residence lighting fixtures.

PORTABLE ELECTRIC GRINDER. — The Black & Decker Manufacturing Company, Towson Heights, Baltimore, has recently placed on the market a portable electric grinder.

UNAFLOW ENGINES.—Bulletin No. 29 recently issued by the Ridgway Dynamo & Engine Company, Ridgway, Pa., describes its unaflow engines.

STAMP VULCANIZER.—The Automatic Electric Heater Company, Warren, Pa., is distributing a leaflet describing its new "Sepco" automatic electric stamp vulcanizer.

STEAM TABLES.—The Wheeler Condenser & Engineering Company, Carteret, N. J., has published the sixth edition of "Steam Tables for Condenser Work."

TRANSFORMERS. — The Enterprise Electric Company, Warren, Ohio, is distributing a four-page pamphlet covering its "Peerless" transformers.

CENTRIFUGAL PUMPS. — "Centrifugal Pumps for Ice and Refrigerating Plants" is the title of leaflet No. 2056 distributed by the Allis-Chalmers Manufacturing Company, Milwaukee, in which it describes its centrifugal pumping units for refrigerating plants.

IRONER.—"A perfect Ironer for One Hundred Dollars" is the title of a descriptive circular issued by the William G. Yates Company, Cleveland, manufacturer of the cottage ironer.

WATER HEATER.—The Aqua Electric Heater Company, 250 West Fifty-fourth Street, New York City, is marketing a new instantaneous automatic electric water heater, 22 x 12 in. x 8 in. for domestic use.

BREAD OVEN.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, has placed on the market a continuous conveyor bread-baking oven in five sizes, baking from 400 to 1,200 1½-lb. loaves per hour.

## New Incorporations

THE S-T ELECTRIC EQUIPMENT CORPORATION, Dover, Del., has been incorporated by B. B. Smith, Thomas J. Turner and Joseph Harris, New York City. The company is capitalized at $500,000 and proposes to manufacture electrical equipment. It is represented by Truston P. Causey, Milford, Del.

THE EASTERN PENNSYLVANIA LIGHT, HEAT & POWER COMPANY, Potter Township, Pa., has been incorporated with a nominal capital stock of $5,000 to install and operate an electric light and power system in this section. L. A. Reinhart, Schuylkill Haven, is treasurer.

THE GAINADAY ELECTRIC COMPANY, Jersey City, N. J., has been incorporated by H. A. Black, John R. Turner and Alfred F. McCable, 15 Exchange Place. The company is capitalized at $200,000 to manufacture electrically operated washing machines.

THE APEX ELECTRIC COMPANY, 1379 Springfield Avenue, Newark, N. J., has filed notice of organization to manufacture electrical apparatus. M. Freund, 946 South Grove Street, Irvington, is interested in the company.

THE KNOWLTON ELECTRIC COMPANY, Framingham, Mass., has been incorporated with a capital of $5,000 to manufacture electrical specialties. Fred W. Spaulding is president and treasurer and Frederick H. Knowlton, Framingham, is secretary.

THE TAYLOR-MALCOLM COMPANY, Albany, N. Y., has ben incorporated by S. and G. B. Taylor and I. Malcolm, Albany. The company is capitalized at $15,000 and proposes to manufacture and deal in storage batteries.

THE TOWNSHEND (VT.) ELECTRIC COMPANY has been incorporated by J. H. Warren, C. H. Willard, C. W. Cutler, W. A. F. Wheeler and F. A. Blood. The company is capitalized at $10,000 and proposes to furnish electricity for lights and power in the towns of Brookline, Newfane and Townshend.

THE MacDOUGALL PROCESS COMPANY, INC., Niagara Falls, N. Y., has been incorporated with a capital stock of $200,000 to manufacture electric products. The directors of the company are A. J. MacDougall, Toronto, Ont.; James G. Rowe and Ray H. Bennett, North Tonawanda.

THE VENICE (OHIO) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000 by John F. Stradtman, B. K. Sessler, Paul R. Grahl, Joseph A. Brunner and Charles C. Trike.

THE ELECTRIC MACHINERY MANUFACTURING COMPANY, Minneapolis, Minn., has been incorporated with a capital stock of $1,000,000 by C. T. Jaffray, E. W. Decker, E. W. Backus, N. V. Wood and Silas McClure.

THE SERVICE ELECTRIC COMPANY, 328 South Seventh Street, Newark, N. J., has filed notice of organization to manufacture and deal in electrical specialties. M. Kern is interested in the company.

THE COLBY LIGHT & POWER COMPANY, Woodland, Me., has been organized with a capital stock of $10,000 to generate and distribute electricity for lighting and power purposes in Woodland. The directors of the company are Frank A. Anderson, president; C. Albion Johnson, treasurer and Frank P. Thomas, clerk.

THE BURNS-POLLOCK ELECTRIC MANUFACTURING COMPANY, Indiana Harbor, Ind., has been incorporated by Anthony J. Burns, Thomas Pollock and J. G. R. O'Hara. The company is capitalized at $1,000,000 and proposes to manufacture electrical appliances.

THE LAGRANGE ELECTRIC COMPANY, Milo, Me., has been organized with a capital stock of $50,000, to generate and distribute electricity for light and power purposes in the town of Lagrange. The directors of the company are Julian d'Este, president; John N. d'Este, treasurer and Cecil D. Towne, clerk, all of Milo.

THE UNION-FORT SPRING POWER COMPANY, Union, W. Va., has been incorporated with a capital of $30,000 by C. W. Boon, Union, and W. H. Garnet, Fort Spring.

# Record of Electrical Patents

Notes on United States Patents

(Issued May 31, 1921)

1,379,854. LIQUID-TIGHT JOINT FOR PREVENTING LEAKAGE BETWEEN THE TERMINAL RODS AND COVERS OF ELECTRIC ACCUMULATORS; Alfred Dinin, Nanterre, France. App. filed Sept. 4, 1918. Liquid-tight joint.

1,379,881. ARC STRIKING AND EXTINGUISHING APPARATUS; Elmer A. Sperry, Brooklyn, N. Y. App. filed July 22, 1916. Contact bridge gap.

1,379,900. STORAGE-BATTERY PLATE AND PROCESS OF MAKING SAME; Rufus N. Chamberlain, Chicago, Ill. App. filed Sept. 12, 1918. Active material mixed with finely divided wood particles.

1,379,919. MAGNETIC-WAVE THERAPEUTIC APPARATUS; Thomas H. Herndon, Washington, D. C. App. filed Aug. 2, 1920.

1,379,942. ELECTRIC FURNACE AND METHOD OF OPERATING SAME; Frederick T. Snyder, Oak Park, Ill. App. filed Oct. 23, 1913. Automatically regulated.

1,379,971. CIRCUIT CONTROLLER; Clarence T. Evans and Richard B. Hunter, Milwaukee, Wis. App. filed Aug. 27, 1915. For overload and no voltage.

1,379,998. PREPARING FERRIC ARTICLES FOR METALLIC BATHS; James H. Maddy, New York, N. Y. App. filed Nov. 11, 1920. Protecting iron or steel from corrosion.

1,380,034. DRY CELL; William Balderston, Madison, Wis. App. filed Dec. 3, 1919. For use in flashlights.

1,380,039. AUTOMATIC TELEPHONE SYSTEM; W. A. Chapin, Chicago, Ill. App. filed Oct. 28, 1916.

1,380,061. SEAL FOR STORAGE-BATTERY TERMINALS; Clarence W. Hazelett, Lakewood, Ohio. App. filed Aug. 19, 1918. Seals cover and terminal.

1,380,063. ELECTRIC LAMP SOCKET; Harry F. Hitner, Wilkinsburg, Pa. App. filed Dec. 1, 1919. Cheap simple socket.

1,380,091. ELECTRIC LANTERN; Leigh D. Brainerd, Chicago, Ill. App. filed Dec. 31, 1919. May be used in developing films.

1,380,123. PORTABLE LIGHTING PLANT; William E. Sullivan, Roodhouse, Ill. App. filed Aug. 2, 1918. Light weight.

1,380,131. CEILING LIGHT; Lauritz W. Anderson, Waterbury, Conn. App. filed Aug. 10, 1916. For porches, corridors and the like.

1,380,142. PLATING BATH; Hugo H. Hanson and Albert C. Walker, Bangor, Me. App. filed Nov. 17, 1919. Deposition of zinc.

1,380,143. PORTABLE ELECTRIC LAMP; William A. Harvey, Scranton, Pa. App. filed March 18, 1920. Means for varying degree of illumination.

1,380,144. ELECTRIC CHANDELIER FIXTURE; William A. Harvey, Scranton, Pa. App. filed April 24, 1920. Means for varying the luminosity.

1,380,168. THERMOSTATIC SWITCH; George H. Whittingham, Bancroft Park, Md. App. filed Dec. 20, 1917. Used in operating refrigerating apparatus.

1,380,180. MAGNETO POCKET LAMP; Georges M. Beaudot, Paris, France. App. filed Dec. 9, 1920. No batteries.

1,380,206. VACUUM-VALVE DETECTOR; Roy A. Weagant, Roselle Township, N. J. App. filed March 10, 1917. Not affected by static and high potential.

1,380,248. ELECTRIC FURNACE; Charles H. Priestley, Elizabeth, N. J. App. filed April 24, 1919. Able to withstand increasing gas pressure.

1,380,250. PROCESS OF MOLDING OR SHAPING PARTS IN MOLDS OR DIES; Martin H. Reymond, Anderson, Ind. App. filed Oct. 22, 1919. Electromagnetic induction used as heating agency.

1,380,291. TEMPERATURE REGULATOR; John J. Danylchuk, Saskatoon, Saskatchewan, Can. App. filed March 30, 1920. For electric flat-irons.

1,380,311. AUTOMATIC-CALL CLOCK; Charles R. Bacon, Los Angeles, Cal. App. filed April 21, 1919. For call bells, lamps and the like.

(Issued June 7, 1921)

1,380,353. METHOD FOR TREATING STORAGE-BATTERY SEPARATORS; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed Aug. 26, 1918. For storage.

1,380,354. STORAGE-BATTERY SEPARATOR; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed July 19, 1919. Methods of treating wood.

1,380,357. TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Dec. 28, 1918. Means for selecting operator's position.

1,380,374. SIGNALING SYSTEM; Fred G. Gardner, New York, N. Y. App. filed Nov. 21, 1919. Composite telegraph and telephone.

1,380,419. ELECTRIC MEASURING INSTRUMENT; Frank W. Roller, East Orange, N. J. App. filed Aug. 5, 1916. Hot-wire meter.

1,380,451. TELEPHONE-EXCHANGE SYSTEM; Ray S. Wilbur, Lyndhurst, N. J. App. filed May 13, 1918. Inter-office trunk circuits.

1,380,544. SLEET HAMMER; John N. Duncan, Boone, Iowa. App. filed Oct. 14, 1920. Carried by trolley.

1,380,550. BUSBAR CLAMP; Frank E. Getts, Chicago, Ill. App. filed Sept. 21, 1918. Adjustable to size of bar.

1,380,579. ELECTRIC POPCORN POPPER; Abner R. Neff, Long Beach, Cal. App. filed May 31, 1919.

1,380,656. ELECTRIC OVEN FOR COOKING PURPOSES; Clarence H. Lauth, Islington, London, England. App. filed June 16, 1920.

1,380,663. WIRELESS CONTROL DEVICE; John Lindgren, Lemont, Ill. App. filed May 16, 1918. For synchronizing movement of armature located at a distance.

1,380,679. PRINTING-TELEGRAPH SYSTEM; Paul M. Rainey, Glen Ridge, N. J. App. filed May 8, 1918. Ready intercommunication established.

1,380,684. TROLLEY HARP; Roy C. Showalter, Altoona, Pa. App. filed March 15, 1921. Novel contact spring.

1,380,696. MOTOR CONTROLLER; Charles W. Yerger, Milwaukee, Wis. App. filed June 23, 1919. Resistance control.

1,380,711. ELECTROLYTIC PRODUCTION OF ZINC; Arthur E. Hall, Omaha, Neb. App. filed July 15, 1915. From oxidized zinc ores, etc.

1,380,712. PURIFICATION OF ZINC-BEARING SOLUTIONS; Arthur E. Hall, Omaha, Neb. App. filed Jan. 7, 1916.

1,380,751. REPEATER-NETWORK-SELECTING APPARATUS; John F. Toomey, New York, N. Y. App. filed July 9, 1919. Telephone repeaters.

1,380,753. ELECTRIC STOVE; Leo Trouilhet and Gaston Duveau, Lyons, France. App. filed Nov. 19, 1919.

1,380,764. SYSTEM OF ELECTRICAL REGULATION; Ernst Bauer, Niagara Falls, N. Y. App. filed Jan. 25, 1918. For electric lighting of railway cars.

1,380,767. PROCESS FOR MELTING METAL TURNINGS, METAL BORINGS, ETC.; William K. Booth, Chicago, Ill. App. filed Dec. 3, 1919. Electric furnace.

1,380,770. STORAGE-BATTERY CONSTRUCTION; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed Sept. 20, 1919. Several cells in one jar.

1,380,809. ELECTRICAL BATTERY AND BULB TESTER; William B. Kouwenhoven, Baltimore, Md. App. filed July 10, 1920. For use in stores.

1,380,852. ELECTROLYTIC APPARATUS; Henri Tobler, Hackensack, N. J. App. filed June 19, 1918. For production of hypochlorites.

1,380,853. ELECTROLYTIC APPARATUS; Henri Tobler, Hackensack, N. J. App. filed Nov. 8, 1920. For production of hypochlorites.

1,380,857. TELEPHONE-EXCHANGE SYSTEM; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed Dec. 31, 1919. Automatic.

1,380,871. APPARATUS FOR MAGNETIC SIZING AND GRADING OF ORE; Walter G. Swart, Duluth, Minn. App. filed Sept. 11, 1917. Magnetic sizing and grading.

1,380,872. RADIO-COMMUNICATION TRANSMITTER; Roy E. Thompson, New York, N. Y. App. filed Sept. 24, 1917.

1,380,885. ELECTRIC REGULATION; John L. Creveling, New York, N. Y. App. filed Jan. 15, 1921. To regulate a dynamo automatically.

1,380,880. LIGHT SUPPORT; Charles S. Farriss, De Land, Fla. App. filed March 24, 1919. Possible to tilt at various angles.

1,380,941. ELECTRICAL SYSTEM OF POWER TRANSMISSION AND REGENERATIVE BRAKING; Clinton J. Axtell, Schenectady, N. Y. App. filed Feb. 4, 1918.

1,380,943. SUBMERSIBLE MOTOR; William Baum, Milwaukee, Wis. App. filed Sept. 27, 1917. For pumping in ships, etc.

1,380,947. SPARK INTENSIFIER; Arthur B. Christopher, St. Louis, Mo. App. filed Oct. 11, 1920. For internal-combustion engines.

1,380,959. TROLLEY-WHEEL ATTACHMENT; William T. Hill, Baltimore Md. App. filed June 28, 1919. To prevent wheel from becoming separated from wire.

1,380,961. ELECTRICITY TRANSFORMING AND CONVERTING APPARATUS; Henry M. Hobart, Schenectady, N. Y. App. filed Sept. 4, 1917. High-tension alternating current into low-tension direct current.

1,380,962. STORAGE-BATTERY GRID; Walter E. Holland, Philadelphia, Pa. App. filed July 8, 1918. Increased strength and durability.

1,380,963. STORAGE-BATTERY GRID; Walter E. Holland, Philadelphia, Pa. App. filed Nov. 22, 1919. Cored type.

1,380,975. POWER PLANT; Charles E. Kettering and William A. Chryst, Dayton, Ohio. App. filed Dec. 8, 1919. Farm lighting.

1,380,978. CONVERTER; Willem C. Korthals-Altes, Schenectady, N. Y. App. filed Dec. 22, 1917. Variable voltage.

1,380,981. TELEPHONE; Irving Langmuir, Schenectady, N. Y. App. filed April 21, 1917. Loud-speaking.

1,380,983. CORE FOR ELECTRICAL APPARATUS; Corliss E. Lee, Pittsfield, Mass. App. filed Oct. 18, 1920. Transformer core.

1,381,008. BATTERY GRID; William R. Polk, Atlanta, Ga. App. filed June 16, 1920. Double-lattice grids.

1,381,044. SHORT-CIRCUITING DEVICE; Alfred F. Welch, Fort Wayne, Ind. App. filed Sept. 10, 1917. For starting single-phase motors.

# Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

## New England States

BOSTON, MASS. — Property on Pine Street has been recently acquired by the Edison Electric Illuminating Company, to be used in connection with operations in the Broadway extension district.

READING, MASS.—The Commonwealth of Massachusetts, Metropolitan District Commission, 18 Tremont Street, Boston, is considering the construction of a new electrically operated pumping plant at Reading, to cost about $40,000.

WALTHAM, MASS.—The Edison Electric Illuminating Company has filed petition with the City Council for the construction of a conduit from the Watertown line through River, Newton and Pine Streets to the electric power station for the purpose of providing another source of power supply.

## Middle Atlantic States

BINGHAMTON, N. Y.—The Council has authorized the installation of ornamental lamps on Water Street between Court Street and the north line of the waterworks property.

CORINTH, N. Y.—Application has been made to the Public Service Commission by the Corinth Electric Light & Power Company for approval of a franchise to install and operate an electric system in the eastern district of Corinth Township for a period of ten years.

CORTLAND, N. Y.—Bids will be received by Dr. Frank B. Gilbert, acting commissioner of Education, Education Building, Albany, until July 7 for the construction,

heating, sanitary and electric work, State Normal and Training School, Cortland. L. E. Pilcher, Capitol, Albany, is state architect.

ITHACA, N. Y.—The Tompkins County Power Corporation, a new subsidiary of the Associated Gas & Electric Company, has purchased the power plant of the Ithaca Traction Corporation. Contracts have already been let for an additional 1,500-kw. steam turbine and one 500-hp. boiler, etc. Present plans call for an expenditure of about $150,000 at the present time, with an ultimate total expenditure of $500,000.

LANCASTER, N. Y.—Plans are under way by the Depew & Lancaster Light, Power & Conduit Company for the construction of a new electric power plant.

LONG ISLAND CITY, N. Y.—The Loft Candy Company, Broome and Center Streets, New York City, is considering the construction of a new one-story power house at its plant on Hamilton Street, Long Island City. Tenney & Ohmes, 101 Park Avenue, New York City, are engineers.

NORTH TONAWANDA, N. Y.—The installation of an ornamental lighting system in the residential section is under consideration.

PASSAIC, N. J.—Arrangements are being made by the Eastside Business Men's Association for the installation of an ornamental lighting system on Second Street.

PRINCETON, N. J.—Arrangements are being made by the Borough Council for improvements to the street lighting in certain sections of Princeton.

NORTHAMPTON, PA.—Property of the Northampton Traction Company, including traction line, power plant, etc., has been acquired for operation by a bondholders' protective committee, of which C. S. Newhall is chairman. Extension to the property are under consideration.

PHILADELPHIA, PA.—Fels & Company, Seventy-third Street and Woodland Avenue, manufacturers of soap, contemplate the installation of additional electrical equipment, including a 1,000-kw. turbo-generator set and a 1,000-kw. motor generator set.

PITTSBURGH, PA. — Plans are under way for the installation of a new street-lighting system on Bigelow Boulevard, East Ohio and Ferry Streets and Second Avenue. Cluster lamps will be used. Arrangements have also been made with the Duquesne Light Company for the removal of a number of wooden poles now in use in the city and substituting iron service standards and also for placing wires underground wherever it is possible.

READING, PA.—The City Council has plans under way for the construction of a new electric power plant on Madden Creek. E. B. Ulrich, city hall, is engineer and Louis T. Klauder, Pennsylvania Building, Philadelphia, is consulting engineer.

WILKES-BARRE, PA. — The question of placing underground the wires on South Main Street is under consideration.

ANNAPOLIS, MD.—The Harper's Ferry Electric Light & Power Company has been granted permission by the Public Service Commission to extend its transmission lines to Frederick County.

LAUREL, MD.—The old mill property of the Mount Vernon-Woodberry Mills, Inc., comprising about 216 acres of land, with water-power rights, has been acquired by the Industrial Power Corporation, recently organized. The new company, it is reported, is considering the use of the property for power development. Robert J. and Albert S. Gill, 224 St. Paul Street, Baltimore, are interested in the organization.

BOYDTON, VA.—The Roanoke River Development Company, Mutual Building, has been granted a preliminary permit by the Federal Power Commission for a 50,000-hp. water-power development on the Roanoke River in Mecklenburg County.

RICHMOND, VA. — The Old Dominion Beverage Corporation, 202 Lyric Building, plans to build a new plant, 82 ft. x 125 ft., to cost about $175,000. Electric motors, conveyor systems, transmission equipment, etc., will be required. W. C. Saunders is president.

WASHINGTON, D. C.—A bill has been passed by the Senate appropriating the sum of $200,000 to start work on the construction of a hydro-electric plant at Great Falls. The ultimate cost of the project is estimated between $44,000,000 and $60,000,000.

## North Central States

ESCANABA, MICH.—Tentative plans for the installation of an ornamental lighting system on the part of Ludington Street are under consideration. The Rotary Club is interested.

LANSING, MICH.—Plans have been prepared by the Michigan Agricultural College for the construction of a one-story and basement power plant, 50 ft. x 136 ft., to cost about $150,000. E. A. Dowd, 127 Allegan Street, is architect.

MONROE, MICH.—Plans are being prepared by the Detroit Edison Company for extensions to its transmission lines in the vicinity of Monroe.

BEDFORD, OHIO.—The B. L. Marble Chair Company has entered into contract with the H. K. Ferguson Company, Cleveland, for the construction of a three-story-and-basement building, 80 ft. x 300 ft., for the manufacture of hardwood office chairs. The company is also considering the construction of a new power plant. The cost of the building and equipment is estimated at $400,000.

CLEVELAND, OHIO.—The City Council has adopted resolutions providing for the installation of an ornamental lighting system on Hough Avenue from East Seventy-ninth Street to East 105th Street, Superior Avenue from East Fifty-fifth Street to the boulevard and Woodland Avenue from East Fifty-fifth Street to East Seventy-ninth Street.

LEIPSIC, OHIO. — The North Western Ohio Light Company has been authorized by the Commissioners to erect a high-tension transmission line from its power plant at Leipsic to Ottawa.

SPRINGFIELD, OHIO.—The installation of electric lighting in the Melrose district is under consideration.

LEXINGTON, KY.—Improvements at the University of Kentucky, including the construction of a central power and heating plant, to cost about $400,000, are under consideration.

BRAZIL, IND. — Crawford & McCrimmin contemplate the installation of a turbine-generator set with accessories in connection with changes to be made at its foundry. F. H. Reynolds is vice-president and general manager.

NEW CASTLE, IND.—An appropriation of $30,000 has been made by the City Council for the installation of a new street-lighting system and rebuilding the fire-alarm system. Plans submitted to the Council by Luther Younce, superintendent of the waterworks, provide for the installation of a three-phase, 60-cycle, 2,300-volt, alternating-current generator and a new main switchboard with constant-current regulating transformers.

ATWOOD, ILL. — The Atwood Electric Light & Power Company, recently incorporated, has been granted a charter to generate and distribute electricity. The plans provide for operation of the lighting plant in Hammond, formerly run by Elmer B. Levitt, and the erection of a high-tension transmission line connecting with the Illinois Traction System at Bement and extending same to the towns of Hammond, Pierson, Atwood and Garrett. J. H. McKinney and others are incorporators.

CHICAGO, ILL. — The Illinois Supply Company, importers, 225 North Michigan, is having estimates prepared for a warehouse and factory, each 200 ft. x 1,250 ft. and a power house, to be built at Sixty-fifth Street and Grand Avenue.

ELGIN, ILL.—Plans are being prepared by Victor H. Kassen of the city engineering department for the installation of a new lighting system on two streets, to cost about $5,000.

MARION, ILL.—A petition will be presented to the City Commissioners by J. W. Williams of East Main Street requesting that the ornamental lighting system be extended from its present terminus on East Main Street to the fair grounds.

BRANDON, MINN.—A proposal to issue $15,000 of electric light bonds will be submitted to the voters.

ELSWORTH, MINN.—The question of rebuilding the municipal lighting plant is under consideration.

ST. PAUL, MINN. — Bids will be received by H. W. Austin, purchasing agent, until June 27 for furnishing material and labor for the complete installation of 401 standards mounted with single lamps of 400 cp. on Summit Avenue form Wabasha Street to the Mississippi River boulevard. Plans and specifications are on file in the office of the purchasing agent.

WADENA, MINN.—Plans have been approved for the installation of an ornamental lighting system covering about six blocks. The plans provide for one-lamp standards, two circuits and underground cable. Nels Peterson is village clerk.

DAVENPORT, IOWA. — Work has been started by the Western States Portland Cement Company, Independence, Kan., on the construction of its new plant at Davenport, Iowa, to cost, including machinery, about $2,000,000. The plans provide for a power house, machine shop and other mechanical departments.

CHILLICOTHE, MO.—Plans are under consideration for improvements to the municipal electric light plant. C. F. Adams is president of the Board of Public Works.

INDEPENDENCE, MO. — Bonds to the amount of $35,000 have been voted for improvements to the municipal electric light plant.

SELIGMAN, MO.—The Silver Lake Mining Company is considering plans for the construction of a new power house at its properties. Considerable new mining machinery will also be installed. T. R. Gilliam is vice-president.

## Southern States

GREENWOOD, S. C.—Improvements to the municipal water and electric light plant, including the installation of transformers and regulators, are under consideration. It is also proposed to replace 200-cp. lamps now in use with lamps of 400 cp. A. J. Sproles is superintendent.

THOMASTON, GA.—The construction of a power plant at the Thomaston Cotton Mills is under consideration.

PARIS, TENN.—The proposal to issue $250,000 in bonds for extensions to the street-lighting system, rebuilding streets, etc., is under consideration.

GUION, ARK.—Plans are being prepared by the Silica Products Company for the construction of new works for the production of glass sand, with an initial daily capacity of 200 tons. The plans provide for a power plant, elevating and conveying equipment, etc.

CROWLEY, LA.—Bonds to the amount of $100,000 have been voted to rewire the city, install a 500-hp. engine in the power plant, etc.

CASTROVILLE, TEX.—The Gulf Portland Cement Company, 812 Gibbs Building, San Antonio, recently organized with a capital of $3,000,000 contemplates building a cement mill in Castroville. The plans include an electric power plant. W. S. Campbell is president and general manager.

LLANO, TEX.—The J. B. Nelson Quarry Company, Houston, plans to install quarrying works at its granite and marble properties at Llano. The cost of the machinery, with power house, is estimated at more than $200,000.

WEATHERFORD, TEX.—The Weatherford Water, Light & Ice Company is considering extensions to its electric power plant.

## Pacific and Mountain States

TACOMA, WASH.—An ordinance was recently passed by the City Council providing for the installation of a street-lighting system on J Street, from Division Avenue to Center Street, to cost about $16,630.

COLORADO SPRINGS, COL.—Bids will be received by the City of Colorado Springs until June 29 for the installation of an ornamental lighting system on Colorado Avenue from Rio Grande viaduct to Thirty-first Street. The plans provide for 198 single-lamp standards, current regulators, poles, cables, lamps and accessories. The cost is estimated at $30,000. W. D. Hoffeditz, Colorado Springs, is engineer.

COLORADO SPRINGS, COL.—The City Council has authorized the city electrician to prepare specifications and estimates of cost for the installation of an ornamental lighting system on South Tejon Street and new lamps on South Nevada Avenue from Vermijo Avenue to the southern end of the city limits.

*Vol. 77, No. 26* **New York, June 25, 1921** *Pages 1463-1520*

# Electrical World

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W. H. ONKEN, JR., *Editor*

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Baker-Joslyn Co., San Francisco, Los Angeles and Seattle.
Jobbers Supply Co., Minnesota, Transfer, Minn.
Joslyn Mfg. and Supply Co., North Kansas City, Mo.
Southern Jobbers Supply Co., New Orleans, La.
American Jobbers Supply Co., New York City

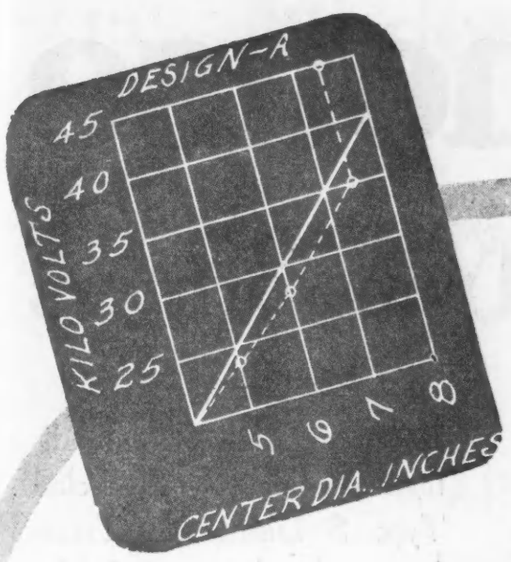
*Sales agents in principal foreign cities*

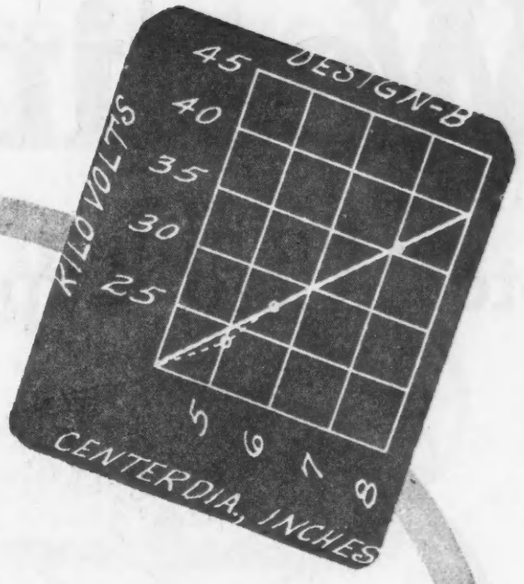
# PINCO

## Insulators

*Next Advertisement:*

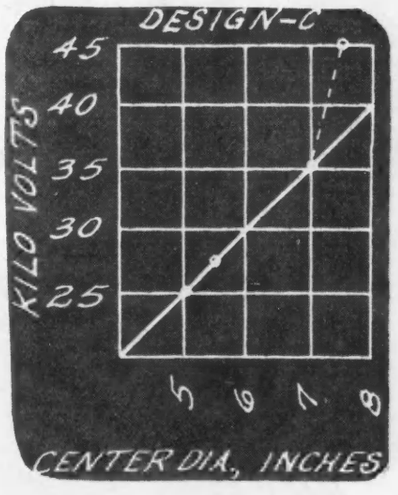
A Comparison between the thickness of PINCO two-piece Insulators and the thickness of other two-piece Insulators.



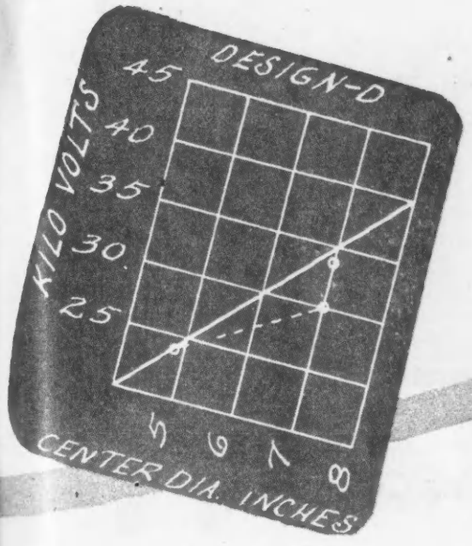

## *Center Diameters Compared*

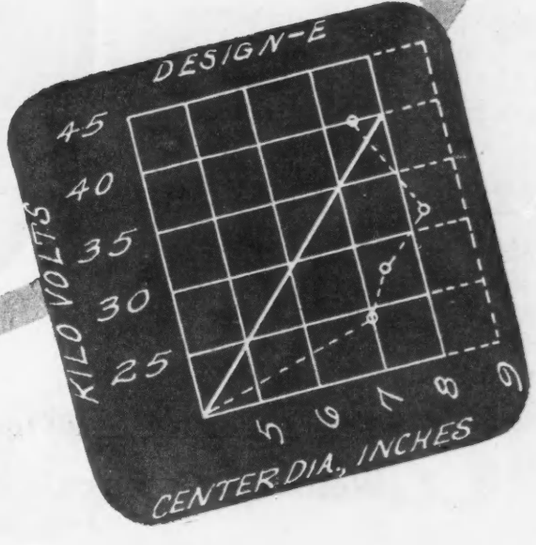
The solid line in each chart represents the dimensions of the center diameters of PINCO Insulators; the dotted lines represent the dimensions of the center diameters of other makes of insulators.




## *Two Section Insulators*

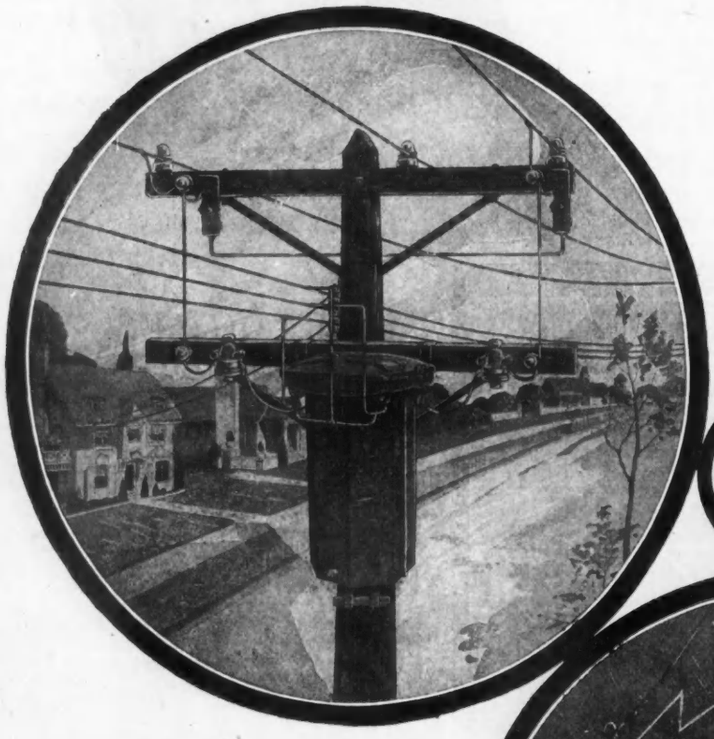
Compare the uniformity of the solid line with the lack of uniformity of the dotted line.



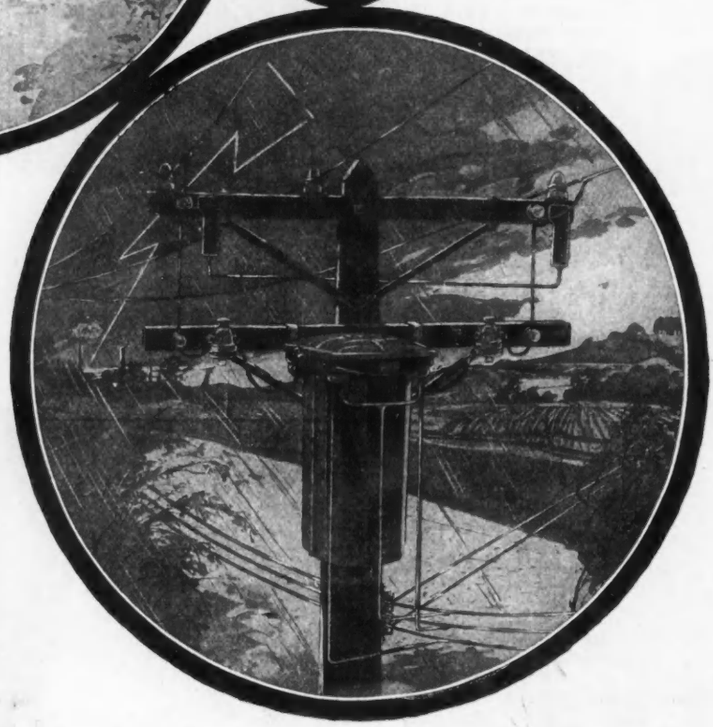



# Westinghouse

## Steel-Clad Type S Transformers



Regardless of weather conditions Westinghouse Steel-clad Type S Distribution Transformers give the same reliable, efficient service.



They are as reliable as the cast-iron Type S Transformers but easier to handle and install, due to the reduction in weight.

For example—the steel-clad 50 Kv-a Transformer weighs less than the cast-iron 25 Kv-a, as is shown by the following figures:

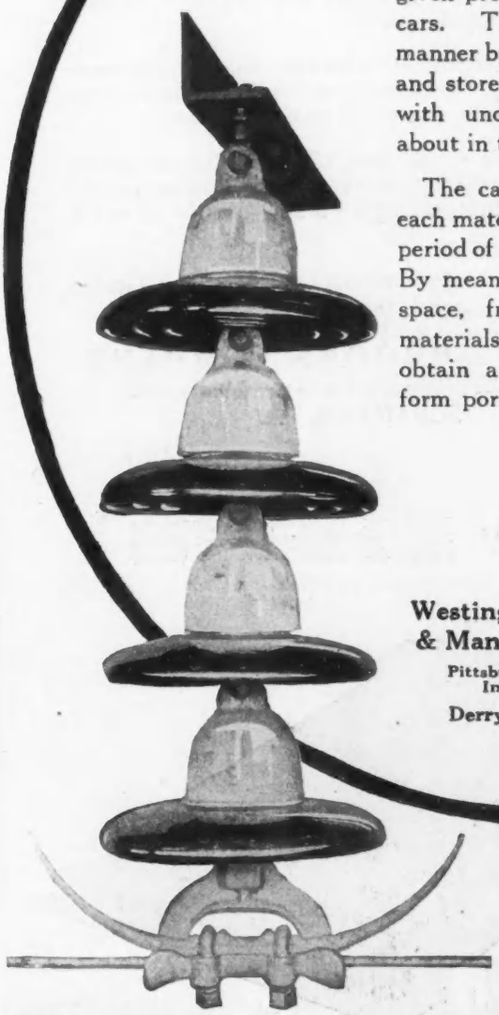
| | Net weight with oil and hangers |
|---|---|
| 25 Kva. cast-iron Type S... | 1042 |
| 50 Kva. steel-clad Type S.. | 1007 |

Therefore, a 50 Kv-a steel-clad Transformer can be mounted on the pole with hangers, with a greater degree of safety than a 25 Kv-a cast-iron type.

*Ask for Circular 1607*

**Westinghouse Electric & Manufacturing Company**
**East Pittsburgh, Pa.**

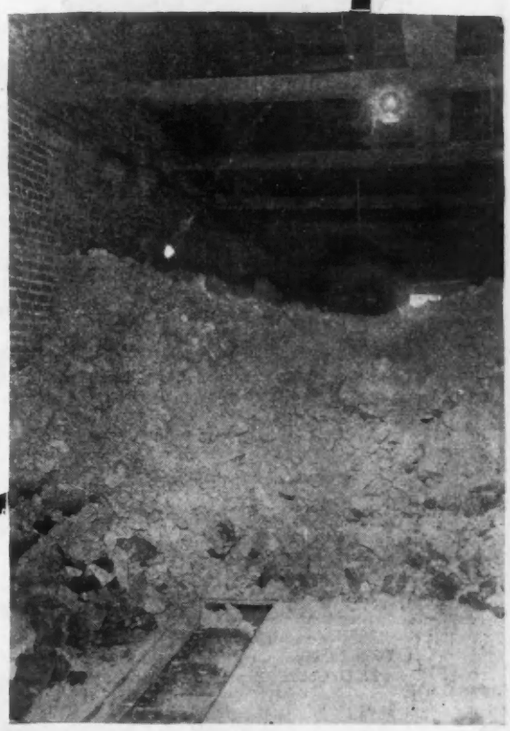
# Modern Production of Suspension Insulators



## The Storage Bins

The raw materials upon arrival at the works are given preliminary tests before unloading from the cars. They are then unloaded in an efficient manner by means of suitable conveying equipment, and stored in large bins to prevent contamination with undesirable substances which are carried about in the air.

The capacity of the storage bins available for each material is sufficient to operate the works for a period of five or six months. By means of such storage space, free from foreign materials, it is possible to obtain an extremely uniform porcelain body.



**Westinghouse Electric & Manufacturing Co.**
Pittsburgh High-Voltage Insulator Works
Derry, Pennsylvania

# Westinghouse

# Getting Wasteless Combustion by a combination of McClave Grates or Stokers with Argand Blower

McClave GRATES STOKERS STEAM BLOWERS AB

IT is the waste in combustion which makes the fuel bill the biggest item in the operating costs of the boiler house.

It is not possible to utilize every bit of fuel heat. But in the average plant with old firing methods, wasted heat may be reduced from twenty to sixty per-cent with proper combustion.

Fuel economy may be further increased through the use of lower grades of coal. These grades sell for lower prices because few plants are equipped to burn them successfully.

But with the proper grates and adequate blast the very poorest grades may be substituted for the high grades previously used.

Nearly forty years of successful development are back of McClave Grates and Stokers. They are made in types adapted to the burning of all grades of coal.

In combination with Argand Blowers they will burn, successfully and economically, anthracite screenings, slack from bituminous coals and lignite, sweepings or coke breeze.

The savings from this single item of the difference in cost between high and low grades of coal, is a very substantial one for every plant owner who is seeking for a new avenue of worth while economies.

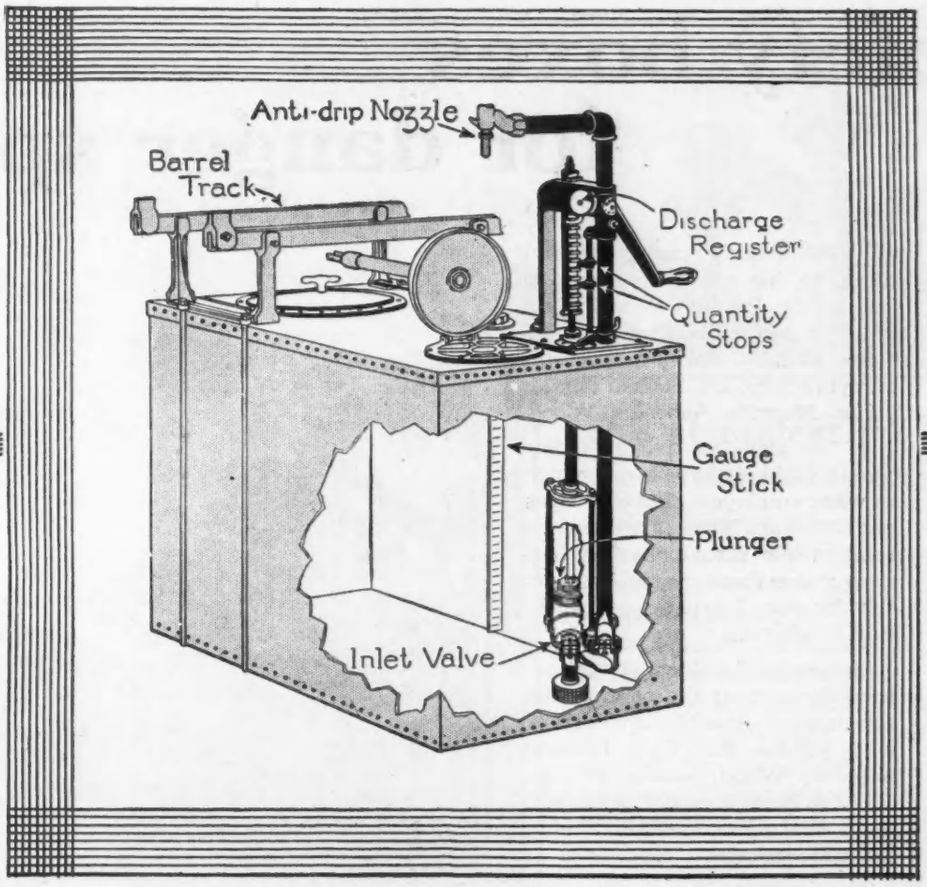
Write for more information about McClave Grates, Stokers and Argand Blowers.

**McCLAVE-BROOKS COMPANY**
**Makers of the famous McClave Grates since 1883**
**SCRANTON, PA.**

McCLAVE HAND-FIRED STOKERS
Showing full "kicker" movement (above) and partial "kicker" movement (below)

**New York Office:**
S. C. Smith, Mgr. 1502 Printing Crafts Building
**Chicago Office:**
F. G. Smith, Western Mgr. 515 Hearst Building
**Philadelphia Office:**
Geo. Blair Jr., Rept. 401 Morris Building
**Pittsburgh Office:**
H. L Hergett, Mgr. 1623 Oliver Building
**Boston Office:**
A. R. St. John, Mgr. 261 Franklin Street
**Syracuse Office:**
W. H. Goodrich, Rept. 130 Hope Avenue
**Dallas Office:**
D. G Counts, Rept. 705 Elm Street

McClave COMBUSTION SYSTEMS *for greater economy*




# *Mechanical Perfection Means Profit Protection*

The reasons why Bowser Oil Handling Equipment stores oil economically and safely are shown in the above drawing of the Fig. 64.

The tank being riveted and soldered from inside is absolutely and permanently leak proof.

The pump is rapid in action and equipped with mechanical measuring stops. A liquid test before shipping assures accuracy.

A permanently tight tank avoids loss from leakage—it prevents contamination of oil, and keeps the oil room clean. Thus cleanliness is stimulated on the part of the employee.

The piston-type measuring pump quickly and accurately delivers any desired quantity directly into the receptacle. This prevents overflow of oilers—saves time and oil.

**Write for Illustrated Booklet A-37**

BY INVITATION MEMBER OF

## S. F. Bowser & Co., Inc.

**1337 Creighton Ave., Ft. Wayne, Ind.**

*Sales Offices (with Service Departments) throughout the United States and in Principal Cities of the World*

S. F. BOWSER & CO. OF TEXAS
DALLAS

S. F. BOWSER CO., LTD.
TORONTO

BOWSER
ESTABLISHED 1885
PISTON-TYPE MEASURING PUMPS

# Safety boxes for danger spots

HERE are a couple of rows of big circuit breakers at one of the Pacific Gas and Electric Company's San Francisco stations. Notice the way the current-carrying parts are housed in with Johns-Manville Asbestos Wood.

A few signs or a light railing would probably have been enough to warn employees, but the signs can only warn if they are *seen* and *read,* while actual physical barriers make these circuit breakers safe for even inexperienced workmen or visitors.

Hundreds of utilities and industries throughout the country are safeguarding possible danger spots with Johns-Manville Transite Asbestos Wood, because it is an easily worked, fireproof structural material of great physical and high dielectric strength.

The nearest branch can give you details and prices. Send for the booklet.

**JOHNS-MANVILLE, Inc.**
Madison Ave., at 41st St., New York City
*Branches in 63 Large Cities*
For Canada:
CANADIAN JOHNS-MANVILLE CO., Ltd.
Toronto

JOHNS-MANVILLE SERVICE COVERS THIS CONTINENT

*Through—*

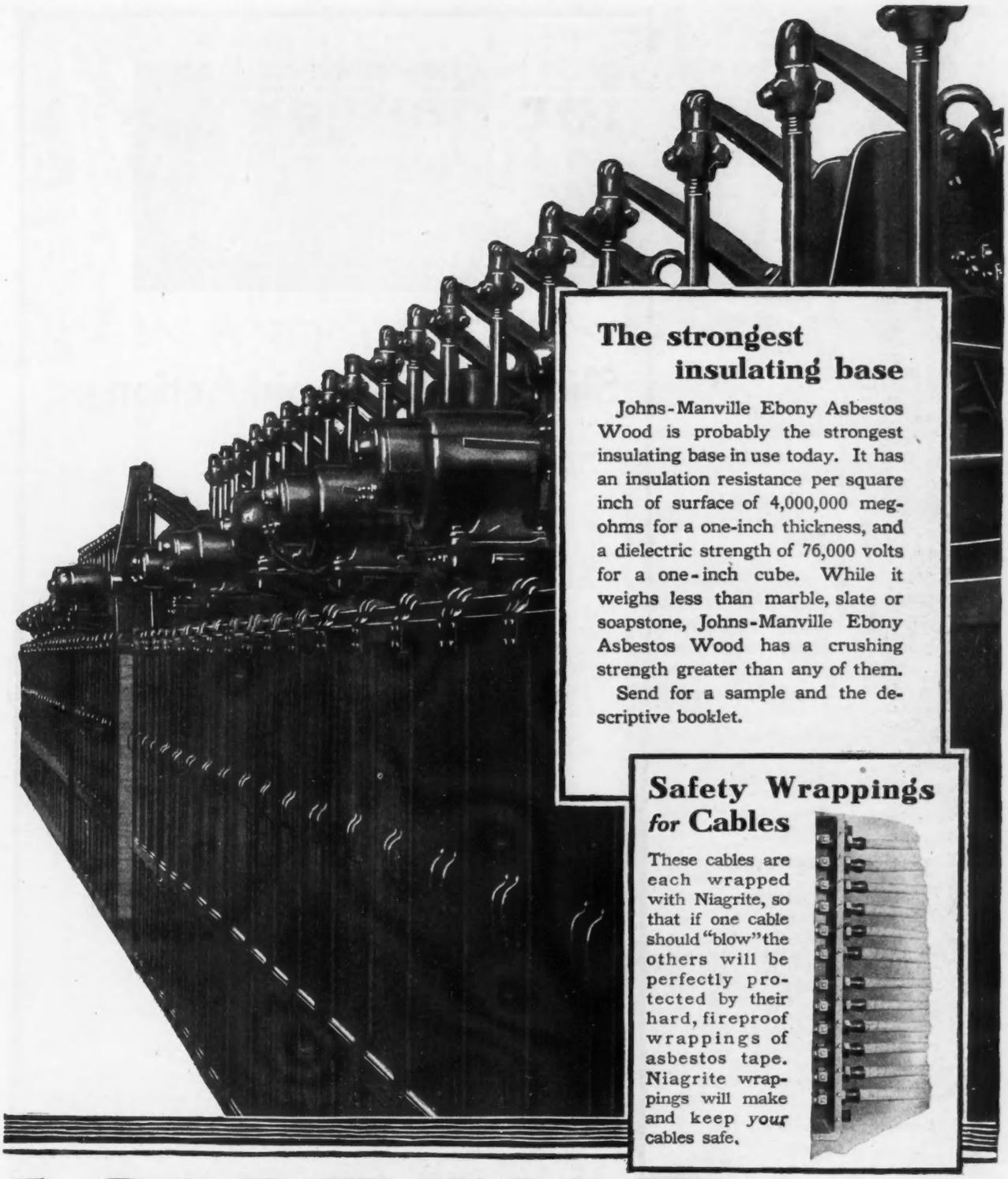
**Asbestos**

and its allied products

JOHNS-MANVILLE
*Serves in Construction*

Heat Insulations, High Temperature Cements, Asbestos Roofings, Packings, Brake Linings, Fire Prevention Products

# JOHNS-Electrical



## The strongest insulating base

Johns-Manville Ebony Asbestos Wood is probably the strongest insulating base in use today. It has an insulation resistance per square inch of surface of 4,000,000 megohms for a one-inch thickness, and a dielectric strength of 76,000 volts for a one-inch cube. While it weighs less than marble, slate or soapstone, Johns-Manville Ebony Asbestos Wood has a crushing strength greater than any of them.

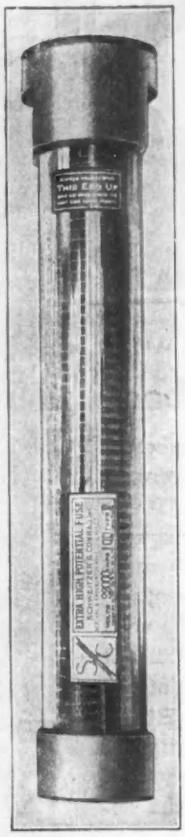
Send for a sample and the descriptive booklet.

## Safety Wrappings *for* Cables

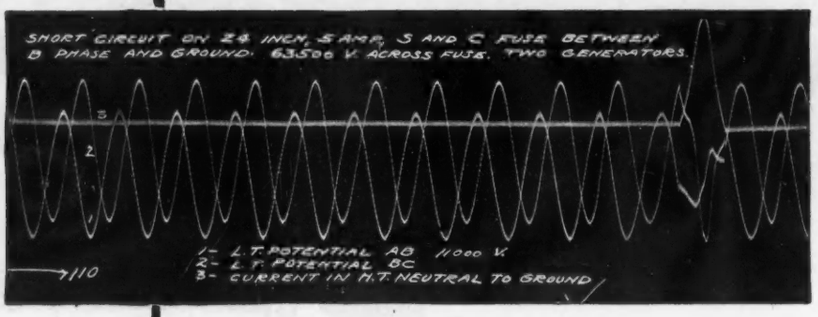


These cables are each wrapped with Niagrite, so that if one cable should "blow" the others will be perfectly protected by their hard, fireproof wrappings of asbestos tape. Niagrite wrappings will make and keep *your* cables safe.

# MANVILLE
# Materials



22,000-volt 100 Ampere Type "D" S & C Fuse


SHORT CIRCUIT ON 24 INCH, 5 AMP, S AND C FUSE BETWEEN B PHASE AND GROUND. 63500 V. ACROSS FUSE. TWO GENERATORS.
1- L.T. POTENTIAL AB 11000 V.
2- L.T. POTENTIAL BC
3- CURRENT IN H.T. NEUTRAL TO GROUND
7110

Oscillogram Record of 66,000 Volt short-circuit

# Showing the Rapid Action of

# High Potential Fuses

One reason for the remarkably successful operation of **S&C High Potential Fuses** is their *extremely rapid action.*

The accompanying oscillogram record is of an **S&C fuse** clearing a 66,000 volt short circuit with two 9,000 KW. generators in parallel. The circuit was cleared in ***one-half cycle,*** or 0.02 seconds. Also note that the fuse opened the circuit the *zero point* at the end of the first cycle.

This rapidity of action has been demonstrated times innumerable in test and under actual service conditions.

The operation of **S&C FUSES** on short circuits is much faster than that of the most rapid oil circuit breaker.

***Write our nearest office for complete data***

**DISTRICT OFFICES:**

**New York:**
30 Church St., Room 503E.
**Boston, Mass.:**
88 Broad St., Room 910.
**Pittsburgh, Pa.:**
Union Arcade Bldg.
**Cleveland, Ohio:**
1202 Illuminating Bldg.
**Indianapolis, Ind.:**
41 No. Capitol Ave.
**Louisville, Ky.:**
323 W. Market St.
**St. Louis:**
1205 Olive St.
**Kansas City:**
717 Bryant Bldg.
**Minneapolis, Minn.:**
1124 Metropolitan Life Bldg.
**Little Rock, Ark.:**
612 A. O. U. W. Bldg.
**Denver, Colo.:**
Denham Bldg.
**Los Angeles:**
208 I. W. Hellman Bldg.
**San Francisco:**
766 Folsom St.
**Seattle:**
L. C. Smith Bldg.
**Portland:**
Lewis Bldg.
**Toronto, Ontario:**
Traders Bank Bldg.
**Winnipeg, Manitoba:**
703 Confederation Life Bldg.
**Vancouver, B. C.:**
1573 Main St.

**Trade Name and Patents**

The correct Trade Name is

**"S&C FUSE"**

but it has been referred to and described as "Carbon Tetrachloride," "Tetrachloride," "Pyrene," and "Chemical" Fuse. The Manufacture, Sale and Use is controlled by United States and Foreign Patents, granted and pending. The S&C FUSE is manufactured in the United States only by

**Schweitzer & Conrad, Inc.**
**Chicago**

# SCHWEITZER S AND C CONRAD, INC.

4435 RAVENSWOOD AVENUE CHICAGO ILLINOIS U.S.A.

# SHIP AND SAIL IN AMERICAN SHIPS

FOR seventy years there has been no American Merchant Marine of sufficient importance to be called such. Before that—back in the days when the clipper ship carried the world's freight—the American skipper was known in every port.

The war came, and with it a need for "ships, money and men." The three were found to fill the need—and the American Merchant Marine came back.

As the steam vessel drove the clipper off the seas, so is the oil-burning American ship once more gaining its old-time place in world commerce.

The ships are there. Good ships, making the ports of all the world, with freight rates and schedules that are on a competitive basis.

"American ships for American goods" is as vital a thought as can be presented to business men. The development of the American Merchant Marine is imperative if America is to progress—and that development is in the hands of American Business to make.

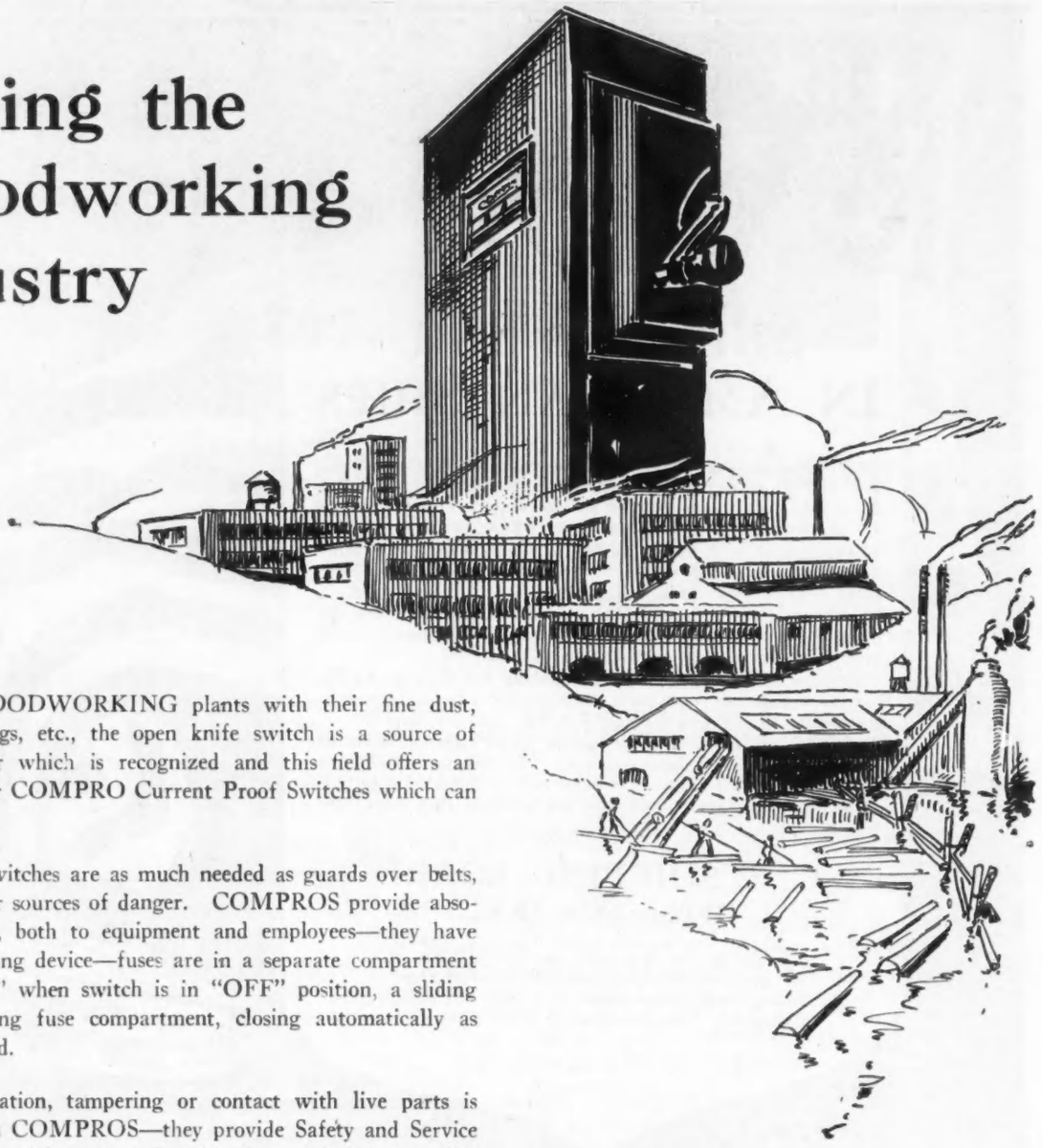
## U. S. SHIPPING BOARD
WASHINGTON, D. C.

*For sailings of passenger and freight ships to all parts of the world write Division of Operations, Traffic Department, U. S. Shipping Board Emergency Fleet Corporation, Washington, D. C.*

D2

AMERICAN SHIPS FOR AMERICAN GOODS

# Serving the Woodworking Industry



IN WOODWORKING plants with their fine dust, shavings, etc., the open knife switch is a source of danger which is recognized and this field offers an opportunity for COMPRO Current Proof Switches which can be capitalized.

COMPRO Switches are as much needed as guards over belts, gears and other sources of danger. COMPROS provide absolute protection, both to equipment and employees—they have a positive locking device—fuses are in a separate compartment and are "dead" when switch is in "OFF" position, a sliding shutter, covering fuse compartment, closing automatically as handle is moved.

Improper operation, tampering or contact with live parts is impossible with COMPROS—they provide Safety and Service which is so essential to the industrial plant and their long life and the reduction they effect in maintenance costs make them a most profitable investment.

*We have an unusually attractive sales proposition —let us send you details.*

*We manufacture all types of enclosed switches for all types of electrical circuits.*

"It Carries Electrical Protection A Step Farther"

**The Wadsworth Electric Mfg. Co.**
Incorporated
**Covington, Ky.**

**COMPRO Current Proof Switch**

Exide
BATTERIES

## Consistently Dependable

Central station engineers, railway signal and car lighting specialists, wireless and telephone experts—skilled men in all lines of work where storage battery power is used—pin their faith to Exide Batteries.

So do hundreds of thousands of motorists, who find in Exide Batteries—with their long life, ample power and greater dependability—the ideal source of power for starting and lighting their automobiles.

For no matter what purpose you select an Exide Battery, there is built into it the power, long life and dependability that comes from 33 years' experience in building storage batteries for every purpose.

*Our engineering department will gladly co-operate with you in solving your storage battery problems, no matter what phase they cover.*

THE ELECTRIC STORAGE BATTERY CO.

Oldest and largest manufacturers in the world of storage batteries for every purpose

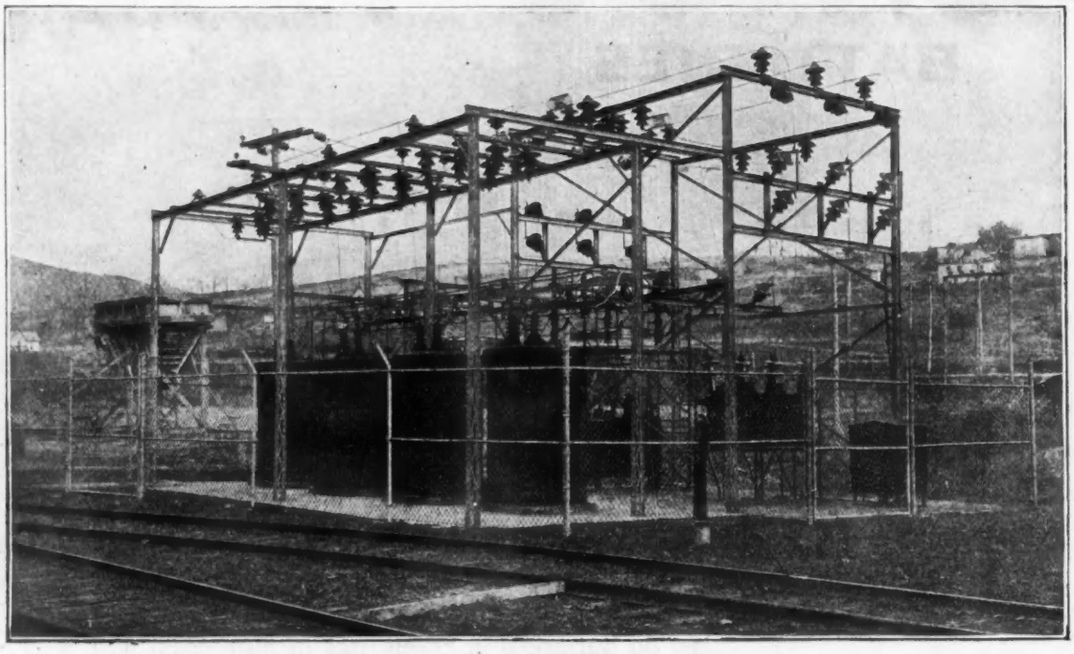
1888 PHILADELPHIA 1921

Branches in 17 cities

Exide Batteries of Canada, Limited,
153 Dufferin Street, Toronto

HIGH TENSION EQUIPMENT

# The Most Powerful Publicity Force In Selling Public Utility Securities Is Outdoor Advertising



Delta-Star Unit-Type Steel Tower 66000/2300 Volt Outdoor Substation

## The Greatest Advertisement

A PUBLIC utility can have is public good will. Success in selling securities depends largely upon the public's opinion of the utility. Service is, of course, one of the most important features. Still its advertising value is of a neutral or negative character, for the public soon gets used to good service, takes it as a matter of fact and does not appreciate it until an interruption occurs.

Delta-Star Unit-Type steel tower outdoor substations have a positive and continuous advertising value, for they attract everybody's attention.

## Unit-Type Substations

ARE landmarks that help build the public utilities' business into the minds of the public, which is the sort of building that makes buyers for utility securities.

The public is impressionable and when day after day they see a modern Unit-Type steel tower outdoor substation—this outdoor advertising is moulding their opinion of the public utility. Utilities are rapidly learning the value of institutional prestige—so more and more they are using the real prestige builders—Delta-Star Unit-Type Steel Tower Substations.

***Would you like to receive Delta-Star publications?***

**Unit-Type will make a good impression on *your* public**

## Delta-Star Electric Company

**2433-59 Fulton St., Chicago, Ill.**

New York, N. Y., 25 Broad St.
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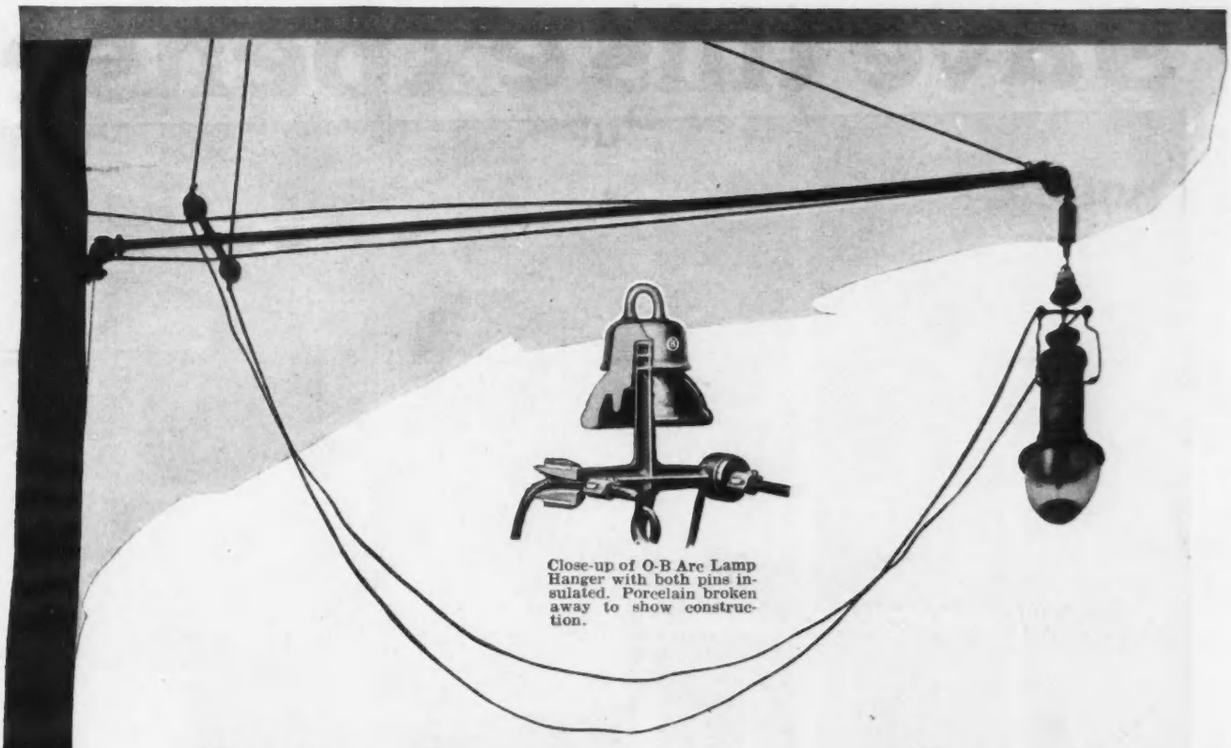
Rochester, N. Y., E. & B. Building
Syracuse, N. Y., City Bank Bldg.
Buffalo, N. Y., 601 Ellicott Square
Columbus, Ohio, 600 Joyce Realty Bldg.
Kansas City, Mo., Interstate Realty Bldg.
St. Louis, Mo., Railway Exchange
Salt Lake, Utah, 59 Broadway
Toronto, Ont., 67 Yonge St.
Indianapolis, 518 Trac. Term. Bldg.
Seattle, Wash., Hoge Building
Philadelphia, Pa., 1333 Real Estate Trust
Los Angeles, Cal., 41 South Main St.
Denver, Colo., 1633 Tremont St.
Pittsburgh, Pa., Union Arcade
Soc. Francaise Ohio Brass & Electric, 7 Rue de Tilsitt, Paris, France.
A-S, Kraftoverforing, Kristiania, Norway
J. J. Niven Co., Wellington, N. J.

DELTA-STAR HIGH TENSION EQUIPMENT

UNIT-TYPE INTERCHANGEABLE PARTS



Close-up of O-B Arc Lamp Hanger with both pins insulated. Porcelain broken away to show construction.

# O-B Arc Lamp Hangers

## More Efficiency for Less Money

Here's once you can get a better article for less money —O-B Arc Lamp Hanger.

It was designed from the distribution engineer's perspective. It includes the things you've wanted and needed in an Arc Lamp Hanger.

O-B Hanger is liberally insulated with rugged, high tension (wet ware) porcelain. The body is sturdy malleable iron—rust proofed. The whole thing is a husky, compact device capable of working hard for a long time.

One of the handy things about it is a clamp which prevents the wire from slipping through the spools.

Sounds too good to be true—all this superiority and a low price. Simplicity is the reason. Order a few and see. We'll leave it up to you.

### A New Kink

O-B Arc Lamp Hangers can be furnished with the conductor grounded to the hanger frame. The clamp pierces the insulation on the conductor.

This gets away from electrolytic action on the conductor. The insulation of one conductor is sufficient to carry the potential across the lamp.

*Prompt shipments*

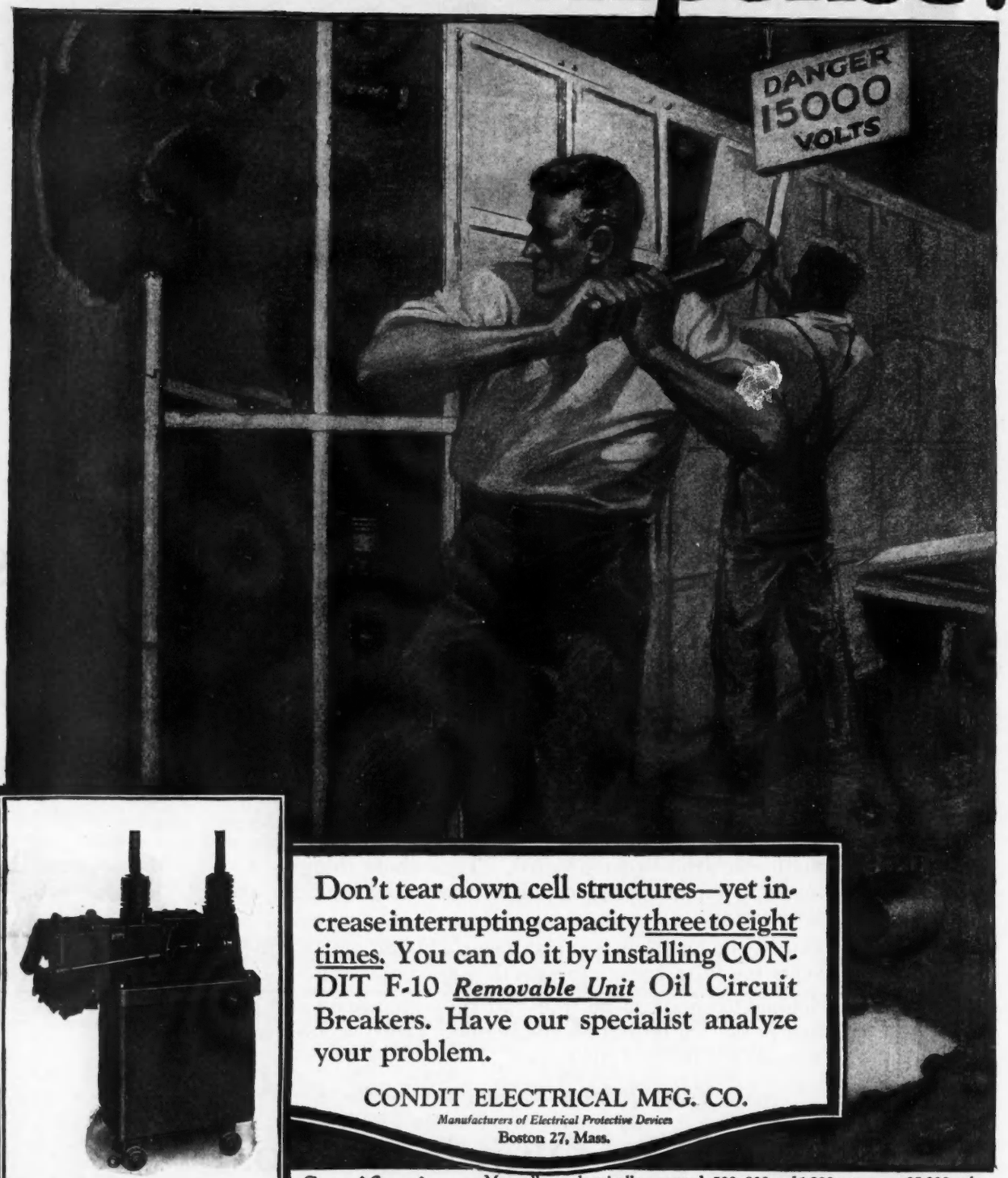
## The Ohio Brass Co.

Mansfield, Ohio

New York Philadelphia Pittsburgh
Chicago Los Angeles
San Francisco Paris, France

*Manufactures:* High Tension Porcelain Insulators; Trolley Material; Rail Bonds; Electric Railway Car Equipment; Third Rail Insulators.

# Save this expense!






F-10 Oil Circuit Breaker

Don't tear down cell structures—yet increase interrupting capacity three to eight times. You can do it by installing CONDIT F-10 *Removable Unit* Oil Circuit Breakers. Have our specialist analyze your problem.

CONDIT ELECTRICAL MFG. CO.
*Manufacturers of Electrical Protective Devices*
Boston 27, Mass.

Specifications: Manually or electrically operated; 500, 800 and 1,200 amperes—25,000 volts; interrupting capacity 10,000 amperes—15,000 volts; 1, 2, 3 or 4 pole.

CONDIT

122-27

ROME WIRE

# We left it there 45 days

Across our macadam driveway, where 5-ton motor trucks, the iron tired wheels of heavy wagons, horses, Fords, workmen—in fact, traffic of every description passed and repassed over it.

After 45 days (and nights) this Super-Service Cord was a little dusty—that's all. It stood the test because its outer wall is tire tread rubber — the same tough, resilient material that is "guaranteed 6,000 miles" and more.

We make Super-Service Cord exactly as they make cord tires: with a loose braid of real *cord* inside—tire tread rubber compound, and *vulcanized under thousands of pounds compression.*

For all portable electric tools Super-Service Cord is ideal. It will not kink or curl, but lies flat on the ground. It can run through water or oil puddles without harm. It may be pulled or tugged at, bent sharply, or dragged over crushed stone, ashes, dirt, or rough boards without harm to the outer wall, or damage to the conductors themselves.

Test it with the cord you are using. Get in touch with us or with your jobber—ask about Rome Super-Service Cord.

**Rome Wire Co., Rome, N. Y.** **Diamond Branch, Buffalo, N.Y.**

NEW YORK CHICAGO DETROIT LOS ANGELES

**SUPER SERVICE CORD**

2020-L

WIRE = ROME

# *Switch-On Little Giants*

THE problem of the hour in leading industries is *lower production costs.* And labor-saving tools are proving themselves a leading factor in its solution.

Especially is this true of Little Giant Portable Electric Drills. Their performance records under hardest conditions and on all classes of work have proved the economy of buying "cheaper *drilling*—not cheaper *drills.*"

The thoughtful tool-room foreman invariably considers *quality first* in specifying tools that occupy the important place in the production program that portable electric tools occupy today. So does the far-sighted buyer who considers future performance ahead of the dollar of today. And the judgment of both in selecting *Little Giants* is confirmed by a large majority of the world's biggest portable electric tool users.

Every electrical and mechanical feature of Little Giant Electric Drills and Grinders reflects *built-in quality.* Ample overload capacity, perfect commutation, long-wearing stub-tooth gears, *full-type* ball-bearings and non-arcing switch control—are a few of these features. Know *all* about Little Giants.

Built in A.C., D.C. and "Universal" types. Write for bulletins.

## Chicago Pneumatic Tool Company

Chicago Pneumatic Building · 6 East 44th Street · New York

*Sales and *Service Branches all over the World*

| | | | | | | | | | | | | | | | | | | | |
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| *Boston | *Cincinnati | El Paso | Houston | *Minneapolis | *Philadelphia | Salt Lake City | *St. Louis | *Berlin | Buenos Aires | *Fraserburgh | Honolulu | Manila | *Montreal | Rio de Janeiro | | Sao Paulo | Tientsin | Vancouver |
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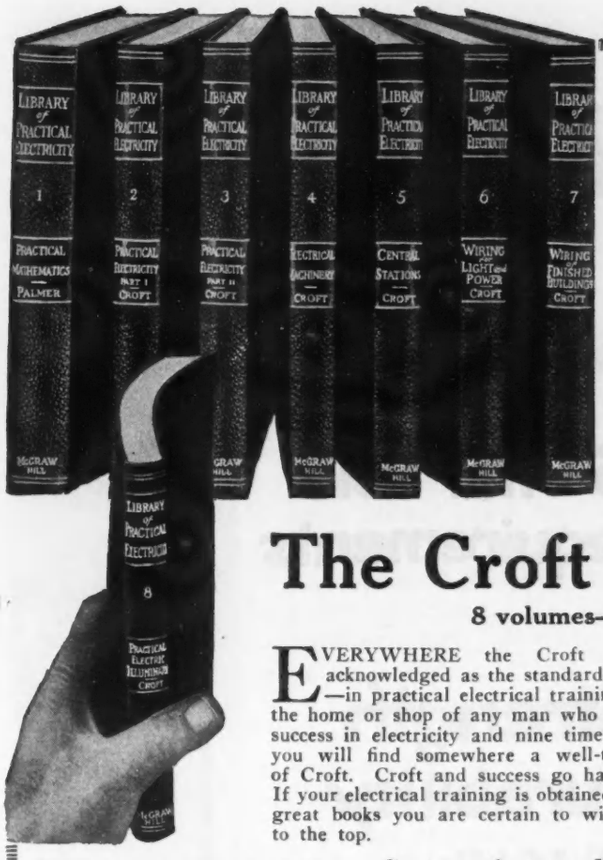
EL 38

BOYER PNEUMATIC HAMMERS··LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS··VACUUM PUMPS··PNEUMATIC HOISTS,
GIANT OIL AND GAS ENGINES — ROCK DRILLS ·· COAL DRILLS

CHICAGO CP PNEUMATIC

**LITTLE** *Electric* **GIANT** *Tools*




# Raise Your Pay With These Books

***"Know electricity as experts know it, and get an expert's pay."***

Big salaries are paid in the electrical field for expert knowledge. The man who knows electricity in all its many phases—the man who has completely mastered the subject from A to Z—can pick his own job and name his own salary. The only way you can earn more is to learn more. Small knowledge means small pay. Learn the way to bigger pay. Become an expert. Croft will show you how.

## The Croft Electrical Library

**8 volumes—3000 pages—2100 illustrations**

EVERYWHERE the Croft Library is acknowledged as the standard—the leader—in practical electrical training. Go into the home or shop of any man who has made a success in electricity and nine times out of ten you will find somewhere a well-thumbed set of Croft. Croft and success go hand in hand. If your electrical training is obtained from these great books you are certain to win your way to the top.

Do not confuse these books with other sets, nor with the average correspondence course. Croft is different. A good thing is always worth doing right, so seven years were spent in getting the library ready. As a result the books stand alone—offering to the ambitious student the utmost in electrical training for the least in money. They are for the man who wants the best—who wants something that will actually help him to fill a bigger job.

***Can you answer these questions?***

1. Are you sufficiently familiar with the operating principles of motors and generators so that you can locate and correct their troubles with a minimum expenditure of time, thought and work?
2. Can you lay out the wiring in your plant so that it is in accordance with the best practice, both electrically and mechanically?
3. If you have a room or building to light can you select the lamps properly and choose the correct reflectors and locate the units at the right heights and in the proper positions?
4. Do you know enough about electric circuits so that you can figure wire sizes, resistances, and the like?
5. Do you really understand the principles of alternating currents and alternating-current circuits—power factor, inductance, reactance, impedance, permittance and the like?
6. Are you familiar with the modern electron theory of electricity which now renders easily understood so many things about electricity that were obscure formerly?
7. If you have to wire an old building with concealed wiring, do you know just how to go about it? Do you know all the time-saving stunts in fishing wires, boring raceways, and how to make the tools required?
8. Do you know the National Electric Code Rules and the reason for their adoption?
9. Can you design a magnet winding?
10. Can you read photometric graphs?
11. Can you handle mathematics practically?
12. Can you design a small switchboard?

***The Croft Library answers these and thousands of other questions.***

***Sent on Approval—No Money Down—Small Monthly Payments***

CROFT has had an almost sensational climb. Beginning as an apprentice lineman, he went through the various stages of wireman, draftsman, etc., until he attained the position of electrical engineer with one of the great electrical manufacturing companies. Now he heads his own consulting company with a large and successful practice, and his name is known in every corner of the electrical world.

### Only Boiled-Down Facts.

Croft gives you only the boiled-down records of everyday electrical practice. His knowledge of electricity has been obtained through actual shirt-sleeve practice, and because he knows your problems he is able to tell you in clear understandable language the best way to solve them.

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The Croft Library at its present low price is a bargain in electrical training. A correspondence course of equal value would cost you $100, or more. Books equal to those in the Croft set, needless to say, cannot be obtained at any price.

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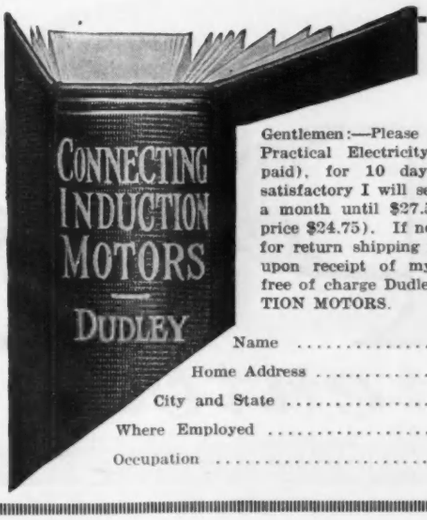
We'll gladly send you these books for ten days' Free Trial. No money needed—no obligation to buy. Use them— test them out any way you please. If you don't think they'll help you send them back. If you keep them you pay only $3 a month for nine months. Mail the coupon today.

### FREE! This Book

This book, Connecting Induction Motors, has been written by one of the best-known authorities on induction motor windings—A. M. Dudley of the Westinghouse Electric and Manufacturing Company. In it he has put the gist of his fourteen years' practical experience. It is a book that every electrical repair man, armature winder and trouble shooter will want. This book enjoys a big sale at its regular price of $2.50, but to you it is free if you send us your order for Croft's Library of Practical Electricity NOW. The book will be mailed promptly upon receipt of your first payment for the library, all charges prepaid.



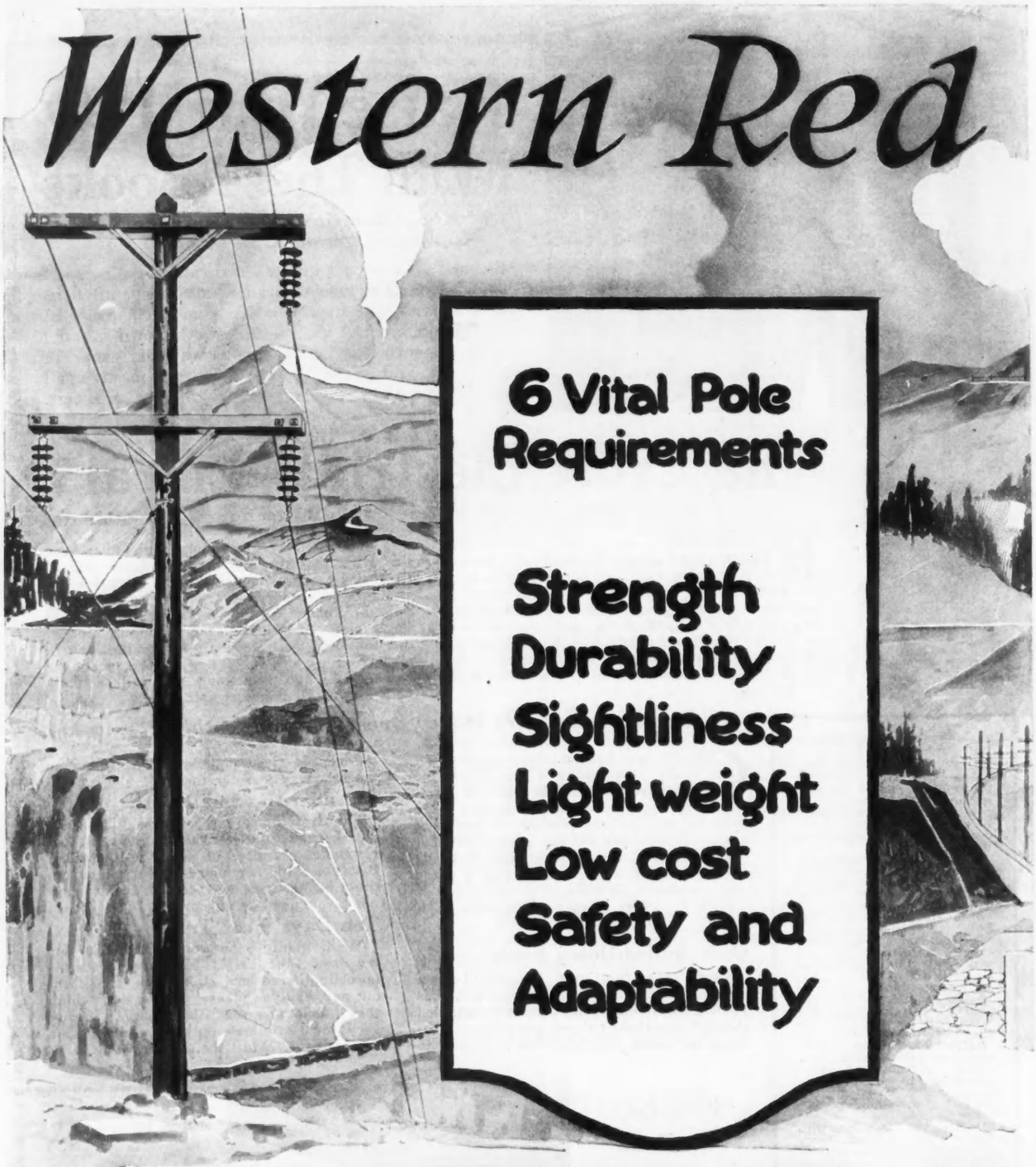

**McGraw-Hill Book Co., Inc.**
**370 Seventh Ave., N. Y.**

Gentlemen:—Please send me the Library of Practical Electricity (Shipping charges prepaid), for 10 days' free examination. If satisfactory I will send $3 in ten days and $3 a month until $27.50 has been paid. (Cash price $24.75). If not wanted, I will write you for return shipping instructions. Immediately upon receipt of my first payment, send me free of charge Dudley's CONNECTING INDUCTION MOTORS.

Name .....
Home Address .....
City and State .....
Where Employed .....
Occupation .....

W-6-25-21

# Western Red



**6 Vital Pole Requirements**

**Strength**
**Durability**
**Sightliness**
**Light weight**
**Low cost**
**Safety and Adaptability**

# PEN

*Patented Process*

# Cedar Poles

## $72,000,000 wasted annually!

U. S. Government experts state $72,000,000 could be saved annually by giving a proper preservative treatment to all poles, posts, and other structural timbers adapted to be so dealt with.

Untreated Western red cedar poles have extraordinary durability. To increase their serviceability, our engineers have developed and patented a new process of butt treating called "Pentrex."

Pentrex Western red cedar poles are machine-punctured before treatment. This insures a scientific penetration of preservative at the groundline area and adds years of life to the already notably durable cedar wood.

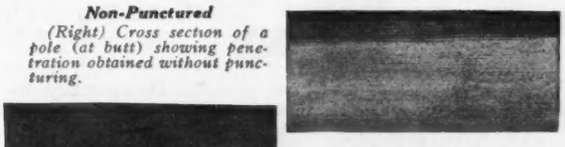
Every engineer should know more about this method and the tremendous economy it effects.

An interesting film showing Pentrex process will be sent to engineering societies or other responsible organizations without charge.

Write now for specifications and full details.

**WESTERN RED CEDAR ASSOCIATION**
**Peyton Building**
**Spokane, Washington**

***Non-Punctured***
*(Right) Cross section of a pole (at butt) showing penetration obtained without puncturing.*

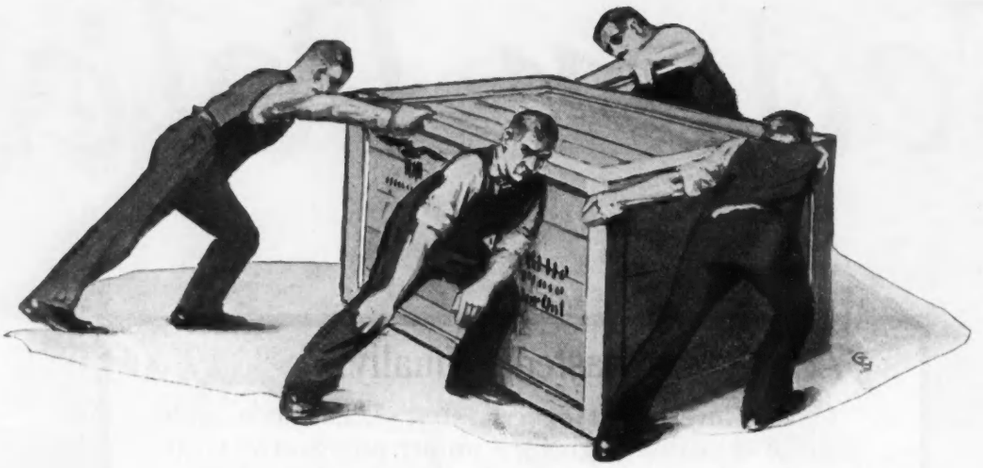




***Pentrex-ed***
*(Left) Same pole showing penetration obtained in area punctured by the Pentrex method.*

# TREX
## of Puncture Treating

(REG. U.S. PAT. OFF.)



# Pulling and Hauling— Shoving, Sweating, Swearing

THAT'S the way they built the pyramids — but the Egyptians weren't building for profit. Shoving, sweating, and swearing in these days drain the dollars out of your profit margin.

## COWAN ELECTRIC Self-Loading Trucks

eliminate wasted time and labor in re-handling loads. Cowan loads are laid on skids instead of on the floor—no handling thereafter. A Cowan Electric operated by *one man* is run under skid—a throw of the controller handle lifting skid and load. At storage point or other destination load and skid are automatically lowered to the floor, ready to be picked up again, in a moment's time, by one-man and a Cowan Electric.

Capacity—5000 pounds; overall length—102 in.; extreme turning radius—7 ft. 5½ in. No shocks transmitted to steering handle. G-E drive and lift motor. "Exide-Ironclad" battery. Vertical lifting platform prevents jamming and damage to loads. Ask for Cowan Bulletins or our nearest representative.

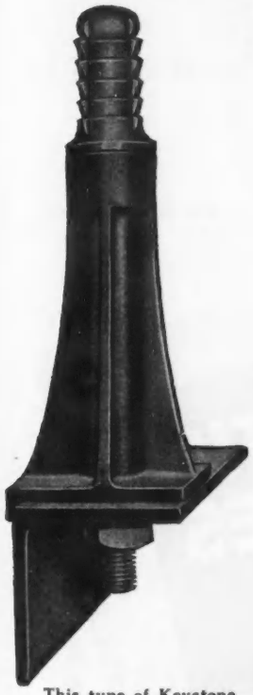
# COWAN TRUCK COMPANY

*Originators of the "through ticket" system for moving loads.*

3 WATER STREET HOLYOKE, MASS.

New York Office: Grand Central Palace 2011-N *Offices in Principal Cities*

# KEYSTONE TRUSS PINS



This type of Keystone Truss Pin is used for Steel Angle Cross Arms.

Keystone Round Top Wood Cross Arm Type.

Keystone Flat Top Wood Cross Arm Type.

## *Whatever the shape of the pole top or cross arm*

Keystone Truss Pins are made in three parts as follows:

1st—A substantially ribbed malleable iron base, shaped to conform to cross arm or other support, with side lips which increase strength of assembly and prevent turning of base.

2nd—A forged steel stud bolt threaded at top to receive thimble and provided with collar to keep it from dropping through base during assembly. Lugs which engage with slots in base prevent turning of bolt both during application of insulator and in service.

3rd—A malleable iron sheradized thimble with rounded top to reduce the electrostatic stress at any one point and its consequent corona effect. It has corrugations designed to increase the holding power of the cement. Made in several styles to fit various types of insulators, all interchangeably drilled and tapped to fit these stud bolts.

***Keystone Truss Pins make your insulators last longer. The bolt absorbs the strain otherwise placed upon the insulator. Write for complete data.***

**ELECTRIC SERVICE SUPPLIES CO.**

*Manufacturer of Railway Material and Electrical Supplies*

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Canadian Distributors: Lyman Tube & Supply Co., Montreal, Toronto, Winnipeg

# Do You Know How Magnetic Clutches Are Used on Various Drives?

Do you know the principle of operation?—how they can be controlled from a remote push button station?—how they extend the use of synchronous type and squirrel cage alternating current motors?

All this is explained and illustrated in a new booklet, typical installations in many industries and on various drives being shown.

Thousands have been put in use during the past 20 years in sizes ranging from 7 to 78-inch diameter, and transmitting from ¼ to 2000 H. P.

You will get some ideas in paging through the new booklet. A copy will be sent on request.

THE CUTLER-HAMMER MFG. CO.
Magnet and Clutch Dept.
New York, Chicago, Pittsburgh, Boston, Philadelphia, Cleveland, Cincinnati, Detroit, St. Louis. Selling Agents: San Francisco, Los Angeles, Seattle: H. B. Squires Co., Birmingham: General Machinery Co.; Salt Lake City: L. Brandenburger; Denver: H. L. Vaughan; Montreal, Canada: The Northern Electric Co., Ltd.; Bedford and London England: Igranic Electric Co., Ltd.

Works: Milwaukee and New York.

*This Booklet tells how Magnetic Clutches are used on various drives.*

***Tear Out***
***This Reminder***

CUTLER-HAMMER MFG. CO.
Milwaukee, Wis.

Please send copy of new publication 2030 on Magnetic Clutches and Their Application.

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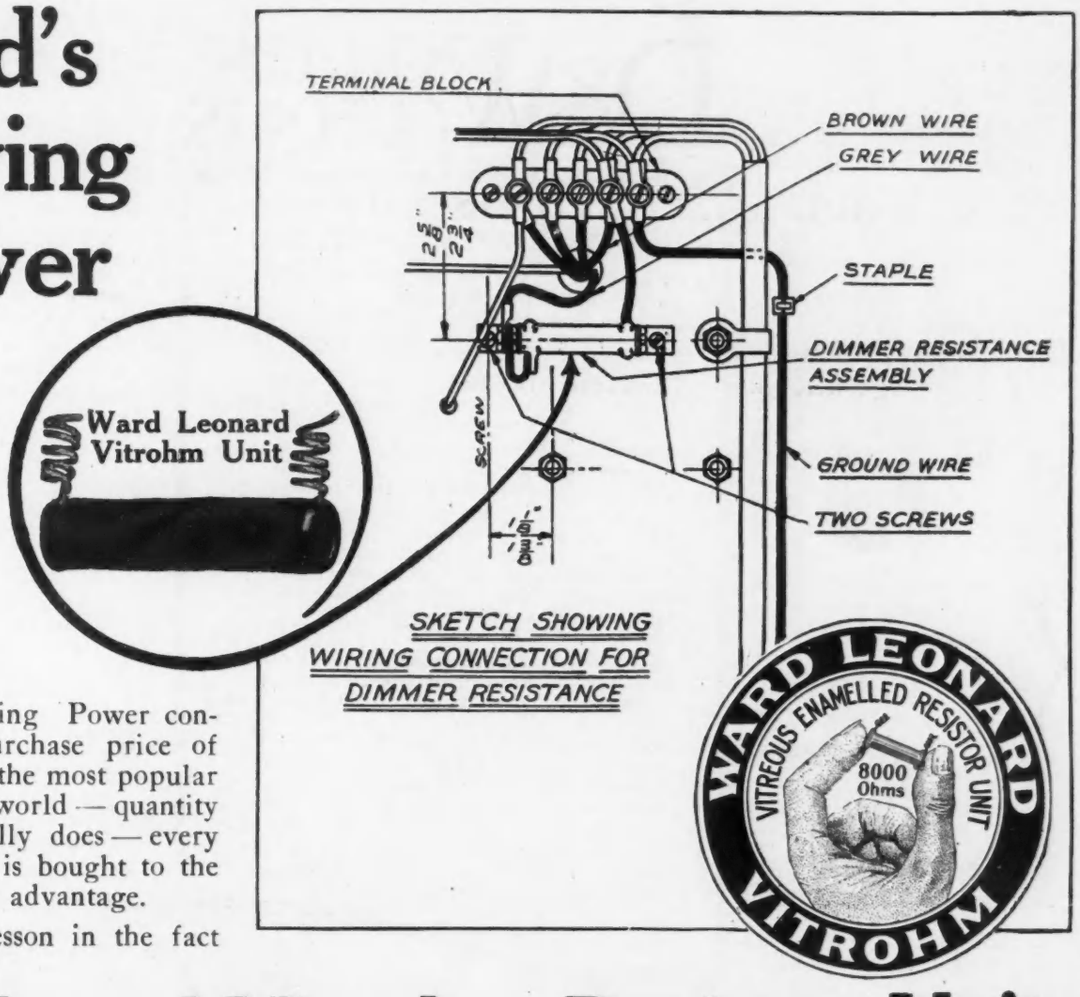
# Ford's Buying Power




SKETCH SHOWING WIRING CONNECTION FOR DIMMER RESISTANCE

Ford's Buying Power controls the purchase price of materials in the most popular car in the world — quantity buying usually does — every article used is bought to the best possible advantage.

There's a lesson in the fact that

# Ford used Vitrohm Resistor Units

in the dimmer lighting circuit as shown.

Vitrohm Resistor Units answered both requirements—low first costs and service to users upon which Ford could depend.

Considering permanence of service-ability, they are cheaper than any other unit on the market.

Vitrohm Units are wound on porcelain Tubes—the best possible insulating material for the purpose, wound with zero-temperature coefficient wire, joints made mechanically and electrically perfect under great pressure—not soldered—and the whole enveloped in Vitrohm Vitreous Enamel—a solid, impervious-to-moisture, fire-proof and heat-radiating insulation which affords full and actual protection and permanent ohmic value to the resistance wire.

If Ford can af-ford to use Vitrohm you cannot afford to overlook it advantages. Examine a free sample Unit which we will gladly send upon request.

## Ward Leonard Electric Company

LOCATED 150 FEET NORTH OF NEW YORK CITY, IN

MOUNT VERNON NEW YORK

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William Miller Tomkins—Philadelphia
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Sperry & Bittner, Inc.—Pittsburgh
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# D&W OIL-FUSE CUT-OUTS

## For Every Service

D & W Oil Fuse Cutouts have become very popular devices for protecting high tension circuits, because they are reliable at all times and the danger in re-fusing them has been practically eliminated.

The Standard Pole type has been designed for ordinary aerial service and is made in four sizes from 50 to 300 amperes at 2500 volts.

The Standard Subway type has been designed for ordinary underground service and is made in three sizes from 50 to 200 amperes at 2500 volts.

The Heavy Service Pole type has been designed to meet severe conditions and is recommended for primary protection near the source of current. This type is made in several sizes from 50 to 200 amperes at 2500 volts; for 4400, 6600 and 13,200-volt lines at 100 and 150 amperes.

The Heavy Service Subway type has been designed to meet the same conditions as the aerial type, but is used in underground work. It is made in three sizes from 50 to 200 amperes at 2500 volts.

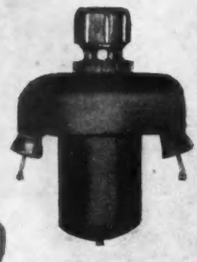
Both Standard Service types are designed to interrupt 10 times normal rating, and in both Heavy Service types are designed to interrupt 25 times their normal rating.

Catalogue No. 2 explains each of the four types in detail and will help you select the best type or types to protect your equipment. Write for a copy today.

*"We have had D & W Oil Fuse Cutouts in service for several years, on aerial and on underground circuits. They are all in use at the present time and have given excellent satisfaction."*

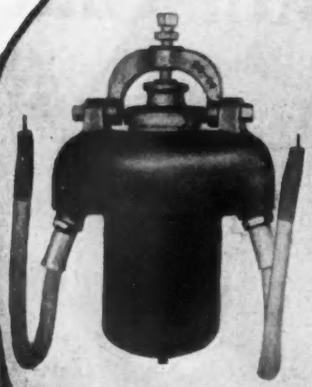
—City of Detroit, Public Lighting Commission

100 Amp.—13200 Volt
Heavy Service
Pole Type

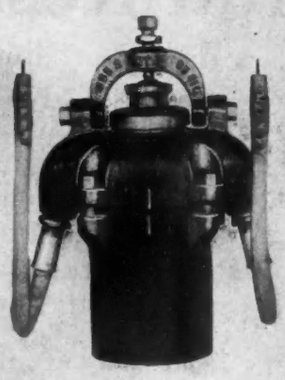


50 Amp.—2500 Volt
Heavy Service
Pole Type

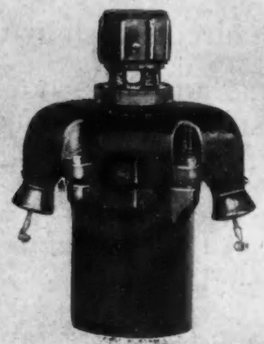
ALL FOUR TYPES



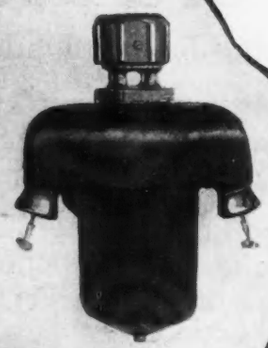
Heavy Service
Subway Type



Standard Service
Subway Type



Standard Service
Pole Type



Heavy Service
Pole Type

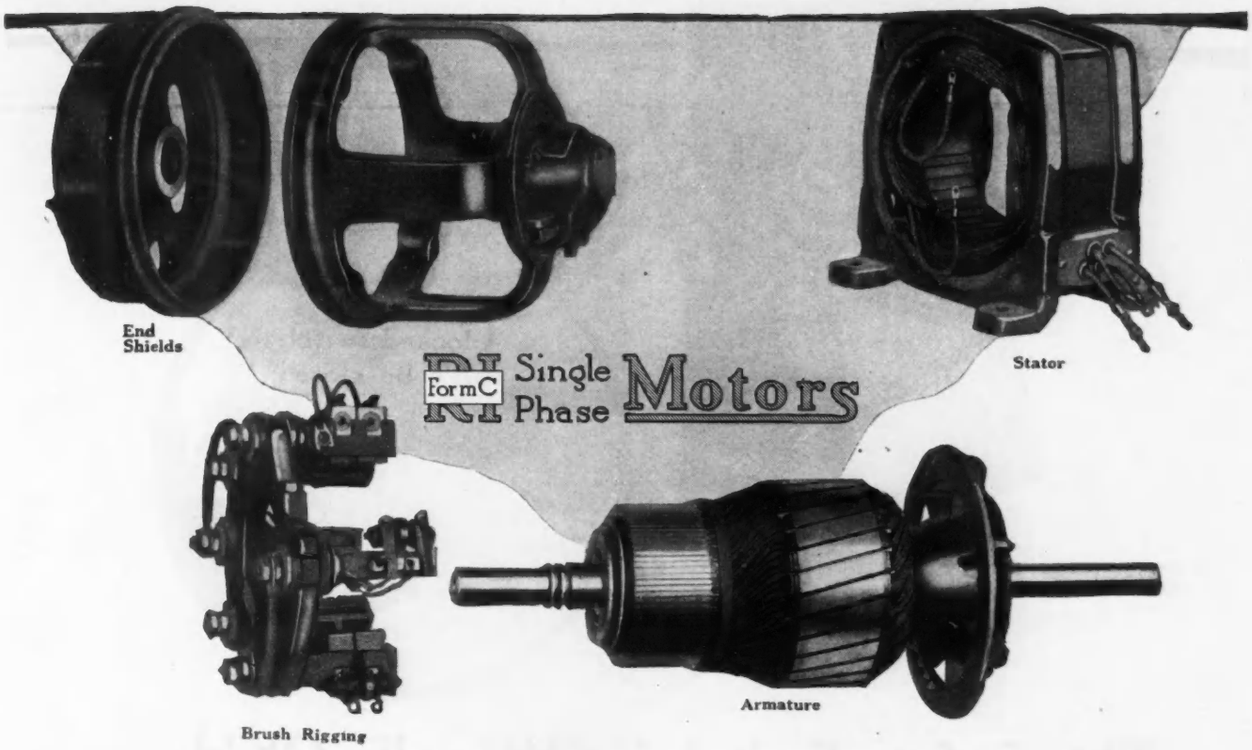
# Fuse D&W Works

of General Electric Company

# Providence R.I.

DWC-27

*Other things being equal, machine reliability increases as the number of parts decreases*




## Only FIVE Principal Parts

With only five principal parts, RI motors appeal to machinery manufacturers demanding simplicity as well as reliability in the driving motor.

### The End Shields

The end shield design permits rigid shaft support and protection to coil ends and armature. Ample space allowed to reach brush rigging.

### The Stator Winding

Employs cotton-covered enameled wire, carefully insulated, repeatedly impregnated with insulating compound and then baked. The use of link windings obviates the necessity of soldering between stator coils.

### The Brush Rigging

Brush yokes are permanently marked for correct brush location for either direction of rotation. The "staggered" brushes are readily removable—provision is made for easy adjustment of brush pressure.

### The Armature

No centrifugal switches or similar starting devices. No tendency to spark. Armatures carefully balanced—heavy shafts hence vibrationless operation.

***All Sizes can be Shipped from Stock***
***Ask nearest G-E Sales Office or Motor Dealer***

**General Electric Company**

General Office Schenectady, N.Y.

Sales Offices in all large cities

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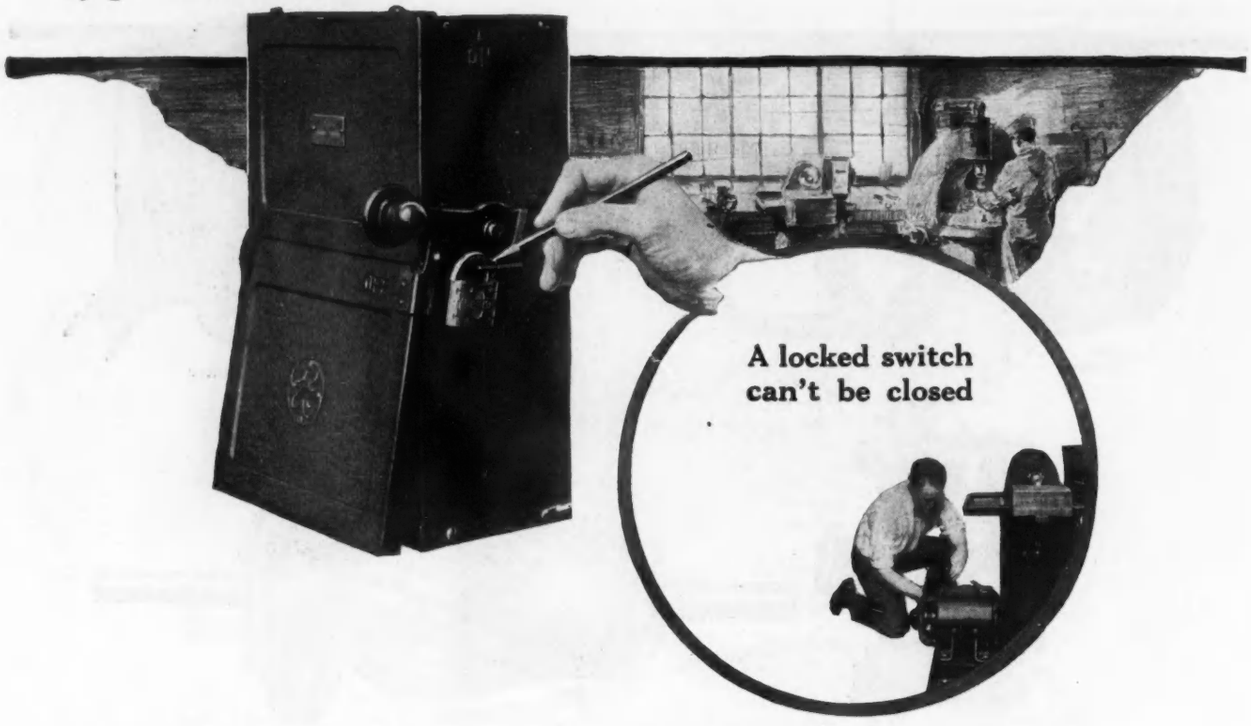
*Safeguarding employees is so important in the industries of today that no wise executive will overlook any safety device of proved value.*




# This Safety Switch is Officially OK'd

The LM line of Safety Enclosed Switches have won the approval of the National Board of Fire Underwriters and met the requirements laid down in the National Electric Code because they afford "Class A" protection, meaning that no live part can be touched.

For simplicity, strength and durability the LMs are not excelled. They are so constructed that they cannot have a dangerous moment.

The ingenious cover will not open unless the switch is thrown to the off position. Once open, the cover can be locked so that a workman making repairs on a circuit controlled by the switch is absolutely safe.

The LMs are made in double, triple and four pole 30, 60, 100 and 200 ampere—250-volt, A.C. or D.C. and will serve on any lighting or power circuit within their rating.

***Send to Section A for Publication 67381***

**General Electric Company**

General Office Schenectady, N.Y.

Sales Offices in all large cities

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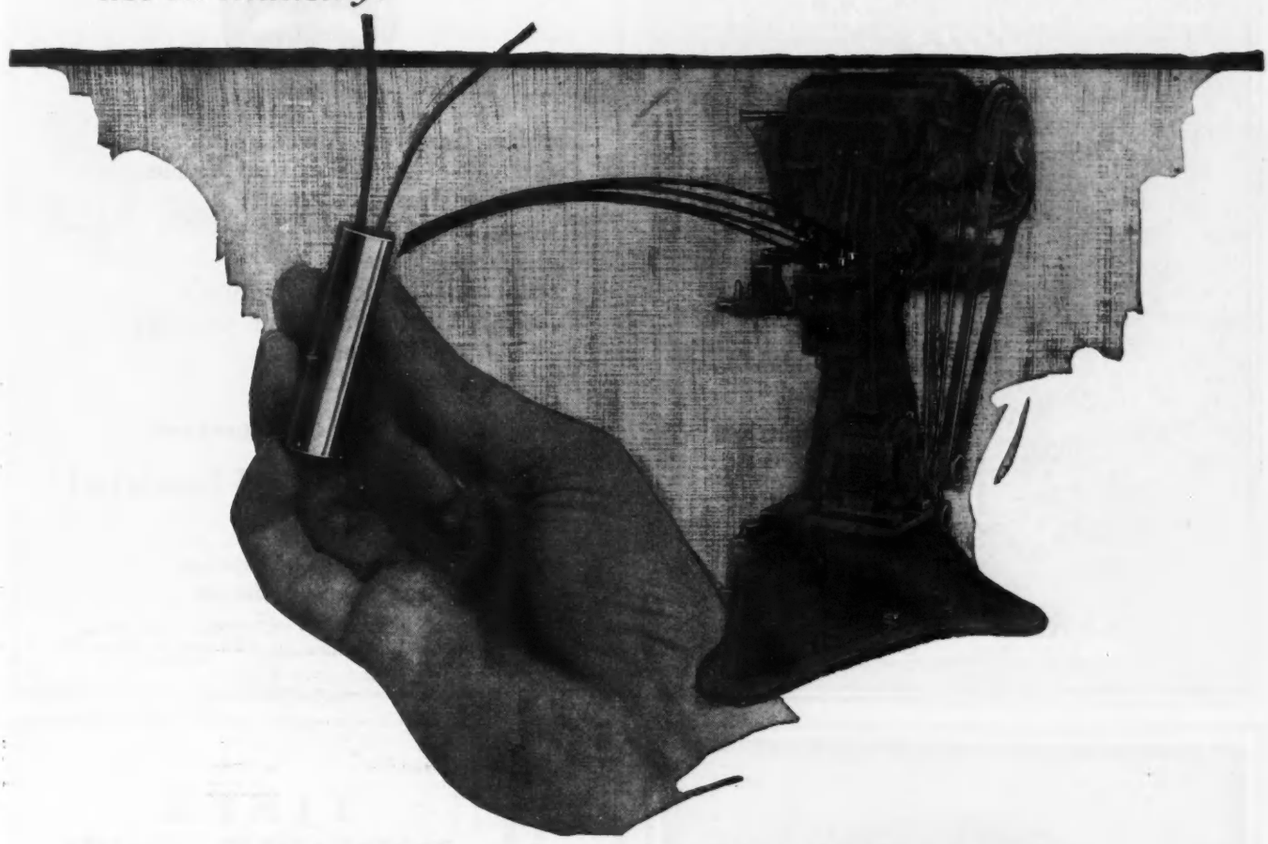
*The simplicity of installing and ease of operating electric heating apparatus, are practical reasons for its increasing use in industry.*



## Thousands of shoe machines are equipped with G-E Cartridge Units

TODAY there are over 100,000 G-E Cartridge Units in daily operation on shoe machines throughout this country. This is not a new application, but a tried and proven adaptation of miniature G-E heating units.

On the machine as shown above the electric unit melts the wax, coats the thread and keeps the thread warm while passing through the machine.

This application only serves to indicate what can be accomplished with modern uses of electric heating. Wherever localized heat is necessary, G-E Electric Units can be applied.

There are thousands of other possible uses. Several are described in Bulletin 69704.

**General Electric Company**

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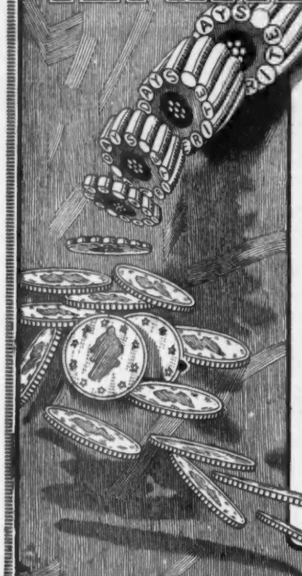
# KERITE

## AN INVESTMENT



When you put your money into KERITE you make an investment in service. You do more than buy conductors, insulation and protection. You obtain the best possible combination of the most desirable qualities in permanent form.

KERITE remains long after the price is forgotten.

KERITE INSULATED WIRE & CABLE COMPANY
NEW YORK CHICAGO

IF IT'S **PARANITE** IT'S RIGHT

**Rubber Covered Wires and Cables**
**Lead Covered Wires and Cables**
**High Tension Cables**
**Automobile Cables**
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***For 30 Years the Standard***

**Indiana Rubber and Insulated Wire Co.**

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# OKONITE

**The Standard for Rubber Insulation**

## VARNISHED CAMBRIC

**Wires and Cables**

are made with the same care and high regard for quality which distinguish the production of OKONITE rubber insulation.

***We are prepared to handle any high grade proposition, and solicit your inquiries.***

*"Manson" Tape (Friction)*
*"Okonite" Tape (Splicing Compound)*

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Passaic, New Jersey
CENTRAL ELECTRIC COMPANY, Chicago, Ill.
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# TIREX PORTABLE CORD

Tirex will increase portable tool efficiency by reducing cord troubles and renewals to a minimum.
It stays on the job from four to five times as long as any fabric covered cord on the market today

**May we send you a sample?**

SIMPLEX WIRE & CABLE Co
MANUFACTURERS
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# $225,770,000

A recent survey by the editorial department of the ELECTRICAL WORLD showed that central stations will spend $225,770,000 for steam, hydro-electric plants and transmission systems in 1921.

ELECTRICAL WORLD reaches nearly 97% of the plants having generator rating of 10,000 KW. and over and 80% of those under 10,000 KW.

Here you have a field that is expanding and a paper that covers the field.

Let ELECTRICAL WORLD help you get your share.

## Electrical World

*The National Exponent of Electric Service*

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AMERICA'S MARKET FOR USED ELECTRICAL MACHINERY

## Big Purchase— 25-CYCLE MOTORS

**The big news of the day is our big purchase of several carloads of very fine 25-cycle, 3-phase motors from the Willys-Overland Co., Toledo. We have decided on a quick turnover of our money on this lot and are offering the motors at a very considerable reduction of our regular schedule. Motors are on hand, available for immediate shipment. Wire us for prices.**

**3-Phase, 60-Cycle Generators**

| Kva. | | Speed |
|---|---|---|
| 1 40 | Westinghouse, 2- or 3-phase, 220- or 440-volt, D.C. to Skinner engine | 300 |
| 1 48 | Electric Machinery, rev. field, 2200-volt | 1200 |
| 1 50 | Gen. Elec., type ATB, rev. field, 440-480-volt | 1200 |
| 1 50 | Gen. Elec., type TRE, rev. field, 240 or 480-v., to New York Safety steam engine | 300 |
| 1 55 | Westinghouse, revolving field, 2200-volt alternator, to McEwen steam engine | 257 |
| 2 60 | Electric Machinery, rev. field, 2300-volt | 900 |
| 1 70 | Westinghouse rev. field, 2400-volt, to Harrisburg-Fleming steam engine | 300 |
| 1 75 | Ridgeway, revolving field, 220-v., to Ridgeway steam engine | 300 |
| 1 75 | Crocker-Wheeler, rev. field, 2300-volt, 2 or 3-phase to McEwen steam engine | 275 |
| 1 100 | Gen. Elec., type TRB, rev. field, 240 or 480-v | 900 |
| 1 100 | Westinghouse, revolving field, 2200-volt | 900 |
| 1 150 | Gen. Elec., type TRB, rev. field, 2200-volt | 900 |
| 1 150 | Gen. Elec., type ATB, rev. field, 2300-volt, to Ideal tandem compound steam engine | 225 |
| 1 200 | G.E., type ATI, 3-phase, rev. field, 2300-volt | 600 |
| 1 225 | Gen. Elec., type TRB, rev. field, 2300-volt | 600 |
| 1 300 | Westinghouse, revolving field, 220-volt, 3-phase, (3-bearing) | 514 |

**250-Volt D.C. Generators**

| Kw. | | Speed |
|---|---|---|
| 1 25 | Westg., MP, type M | 975 |
| 1 25 | Northern, MP | 900 |
| 1 25 | Ft. Wayne, 6-pole | 875 |
| 1 25 | Keystone, MP | 725 |
| 1 25 | G. E., comp. to Ideal horizontal steam engine | 300 |
| 1 30 | Western Elec., MP | 1250 |
| 1 30 | Fairbanks-Morse, MP | 900 |
| 1 30 | Northern, MP | 850 |
| 1 35 | Fairbanks-Morse, comp. interpole | 1125 |
| 1 40 | Northern, comp., to Fleming horizontal steam engine | 320 |
| 1 45 | Westg., MP, type S | 975 |
| 1 50 | Ft. Wayne, 6-pole | 600 |
| 1 60 | Northern, MP | 800 |
| 1 75 | Northern, 6-pole | 525 |
| 1 100 | Milwaukee, 6-pole | 550 |
| 1 125 | Allis-Chalmers, MP | 850 |
| 1 150 | G.E. interpole, 2-bearing | 650 |

**500 -Volt, D.C. Motors**

| Hp. | | Speed |
|---|---|---|
| 1 7½ | G. E., type RC, interpole | 1850 |
| 1 7½ | G. E., type RC, interpole | 1300 |
| 1 7½ | Westg., type SK interpole | 1150 |
| 2 7½ | G. E., type RC, interpole | 900 |
| 1 10 | Westg., type SK, in'pole | 1700 |
| 1 10 | Westg., MP, type S | 1200 |
| 1 10 | G. E., type CVC, int'pole | 900 |
| 3 15 | Westg., type SK interpole | 1700 |
| 1 15 | G. E., type CVC, int'pole | 1350 |
| 1 15 | Fairbanks-Morse, MP | 925 |
| 1 15 | Westg., type SK, int'pole | 825 |
| 1 30 | Gen. Elec., type DLC, interpole | 1250 |
| 1 35 | Gen. Elec., type MP | 850 |
| 2 35 | Crocker-Wheeler, MP | 730 |
| 1 35 | Gen. Elec., MP, type MP | 600 |
| 1 40 | Gen. Elec., type DLC, interpole | 1200 |
| 1 50 | Westg., type SK, int'pole | 975 |
| 2 50 | Westg., type SK, int'pole | 750 |
| 1 65 | Westg., type SA, int'pole | 825 |
| 1 90 | Gen. Elec., type DLC, interpole | 1025 |

**3-Phase, 60-Cycle Motors, 220 or 440-Volt**

| Hp. | | Speed |
|---|---|---|
| 3 25 | General Electric | 1200 |
| 1 25 | Wagner, type 19TBP | 1140 |
| 1 25 | General Electric | 900 |
| 3 25 | Wagner | 850 |
| 1 30 | General Electric | 1200 |
| 2 30 | General Electric | 900 |
| 1 30 | Western Electric, new, 440-volt, slip-ring | 720 |
| 1 30 | Westinghouse, type MS (milltype, heavy duty) | 560 |
| 1 35 | General Electric | 1200 |
| 6 40 | Gen. Elec., type KT | 1200 |
| 2 50 | Gen. Elec., type KT | 1200 |
| 1 50 | Gen. Elec., type KT | 900 |
| 1 50 | Western Elec. (G. E.), type I, form K, with double shaft extension | 900 |
| 1 50 | Allis-Chalmers, type ANY, slip-ring, new, constant speed | 865 |
| 1 60 | Otis | 1200 |
| 2 60 | Western Elec. (G. E.) | 1200 |
| 2 60 | Western Elec. (G. E.) | 900 |
| 1 75 | Gen. Elec., type I, form K | 1800 |
| 1 75 | Gen. Elec., type I, form M, 220-volt, slip-ring | 900 |
| 2 100 | Gen. Elec., type I | 1800 |
| 1 100 | Fairbanks-Morse, type B, 2200-volt | 1200 |
| 2 250 | Gen. Elec., type I, form K, 550-volt | 49 |
| 6 150 | Gen. Elec., slip ring, type I, form M | 600 |

**3-Phase, 25-Cycle Motors 220- or 440-Volt**

| Hp. | | Speed |
|---|---|---|
| 3 | ½ Gen. Elec., type KT | 1500 |
| 4 | ½ Gen. Elec., type KT | 750 |
| 1 1 | Westinghouse | 690 |
| 2 2 | Gen. Elec., type KT | 1500 |
| 2 2 | Emerson | 1450 |
| 3 2 | Gen. Elec., type KT | 430 |
| 1 3 | Westinghouse, type CS | 720 |
| 3 5 | Westinghouse, type CS | 1440 |
| 7 5 | Gen. Elec., type KT | 750 |
| 2 5 | Westinghouse, type CS | 675 |
| 6 7½ | Allis-Chalmers | 750 |
| 16 7½ | Gen. Elec., type KT | 750 |
| 14 10 | Gen. Elec., type KT | 750 |
| 2 10 | Westinghouse, type CS | 750 |
| 1 15 | Westinghouse, slip ring | 710 |
| 8 15 | Gen. Elec., type KT | 750 |
| 11 20 | Gen. Elec., type KT | 750 |
| 1 25 | Sprague (G.E.), form K | 750 |
| 2 25 | Westinghouse, type CS | 730 |
| 1 35 | Allis-Chal., type AN | 1450 |
| 7 50 | Westinghouse | 735 |
| 6 50 | Gen. Elec., type K | 750 |
| 1 60 | Allis-Chal., type AN | 720 |
| 1 65 | Allis-Chal, type AN | 1440 |
| 1 75 | Gen. Elec., form K | 750 |
| 1 100 | Ft. Wayne | 750 |
| 1 100 | Gen. Elec., type ITC, 440-volt, slip-ring, variable speed | 750 |
| 1 150 | Burke, 220- or 440-volt | 375 |
| 2 200 | Burke, 220- or 440-volt | 500 |
| 3 300 | Allis-Chalmers, 220- or 440-volt, new, slip-ring, constant speed | 500 |



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300—3-phase, 60-cycle, 220-440-volt General Electric 40 and 50 Degree Motors in service about one year.

**"Priced Low."**

| Hp. | Type | Speed |
|---|---|---|
| 7½ | KT | 1800 |
| 8 | KT | 1200 |
| 10 | KT | 900 |
| 15 | KT | 900 |
| 20 | KT | 900 |
| 25 | KT | 900 |
| 30 | KT | 900 |
| 35 | IK | 900 |
| 40 | KT | 900 |
| 50 | IK | 900 |
| 60 | KT | 900 |
| 100 | IK | 900 |

Carefully refinished and guaranteed equal to new.

**MOTOR GENERATOR SETS**

| Make | Kw. | D. C. Volt | A. C. Volts | Cycles |
|---|---|---|---|---|
| Gen. Elec. | 1000 | 250 | 2300 | 60 |
| Westghse. | 750 | 125/250 | 2300 | 60 |
| Gen. Elec. | 500 | Freq. Changer | 4150/13200 | 25/60 |
| Gen. Elec. | 500 | 575 | 4150 | 60 |
| Gen. Elec. | 500 | 125/250 | 6600/2300 | 60 |
| Gen. Elec. | 300 | 250 | 2200 | 60 |
| Westghse. | 300 | Freq. Changer | 2300 | 25/60 |
| Gen. Elec. | 200 | 250 | 2300 | 60 |
| Gen. Elec. | 150 | 250 | 2200 | 60 |
| Allis | 150 | 500 | 2300 | 60 |
| Allis | 100 | 500 | 2300 | 60 |
| Gen. Elec. | 100 | 250 | 2300 | 60 |
| Gen. Elec. | 75 | 125 | 2300 | 60 |
| Burke | 75 | 500 | 2300 | 60 |
| Allis | 75 | 250 | 2300 | 60 |
| Allis | 50 | 250 | 220 | 60 |
| Gen. Elec. | 50 | 125 | 440 | 60 |
| Westghse. | 30 | 250 | 440 | 60 |

**DIRECT CURRENT MOTORS**

| Make | Hp. | Rpm. | Volts |
|---|---|---|---|
| General Electric | 105 | 665 | 250 |
| General Electric | 100 | 290 | 250 |
| Crocker-Wheeler | 100 | 900 | 250 |
| General Electric | 75 | 1200 | 250 |
| General Electric | 75 | 1200 | 500 |
| Crocker-Wheeler | 75 | 530 | 250 |
| General Electric | 75 | 700 | 250 |
| General Electric | 70 | 850 | 250 |
| General Electric | 55 | 845 | 250 |
| C. & C. | 50 | 1200 | 250 |
| Westinghouse | 50 | 850 | 230 |
| General Electric | 50 | 900 | 500 |
| General Electric | 50 | 550 | 500 |
| General Electric | 40 | 1150 | 500 |
| General Electric | 35 | 600 | 500 |
| Westinghouse | 30 | 1700 | 230 |
| General Electric | 30 | 750 | 230 |

**D. C. GENERATORS BELTED**

| Make | Kw | Rpm | Volts |
|---|---|---|---|
| Allis | 500 | 360 | 250 |
| General Electric | 400 | 450 | 250 |
| General Electric | 250 | 600 | 250 |
| Allis | 200 | 425 | 250 |
| General Electric | 150 | 550 | 250 |
| General Electric | 100 | 250 | 250 |
| General Electric | 100 | 550 | 250 |
| Crocker-Wheeler | 75 | 1200 | 250 |
| General Electric | 60 | 900 | 250 |
| Westinghouse | 200 | 375 | 125 |
| Triumph | 100 | 500 | 125 |
| General Electric | 75 | 900 | 125 |

**D. C. GENERATORS ENGINE TYPE**

| | | | |
|---|---|---|---|
| Westghse. Erie City | 100 | 250 | 250 |
| Allis-Skinner | 100 | 250 | 125 |
| G-E Buckeye | 150 | 200 | 125 |
| Westghse.-Erie | 150 | 200 | 250 |
| Westghse.—Ball | 200 | 200 | 250 |
| Westghse.—Buckeye | 300 | 150 | 250 |
| G. E.—McIntosh | 450 | 150 | 275 |
| G. E.—Hamilton | 500 | 150 | 250 |

**TURBO GENERATORS 60 CY.**

| | | | |
|---|---|---|---|
| G. E.-Curtis | 500 | 1800 | 2300 |
| G. E.-Curtis | 750 | 1800 | 600 |
| G. E.-Curtis | 1000 | 1200 | 2300 |
| G. E.-Curtis | 1500 | 1200 | 2300 |
| G. E.-Curtis | 2250 | 900 | 2300 |
| G. E.-Curtis | 5000 | 720 | 11000 |

**A. C. GENERATORS ENGINE TYPE**

| Make | Kw. | Volts | Cycle |
|---|---|---|---|
| Westghse.-Fleming | 75 | 2300 | 60 |
| G. E.-Skinner | 75 | 440 | 60 |
| Westghse.-Skinner | 100 | 220 | 60 |
| Ft. Wayne-Skinner | 125 | 2300 | 60 |
| G. E.-Ball | 150 | 220 | 60 |
| Ridgway | 150 | 2200 | 60 |
| G. E.-Erie City | 200 | 440 | 25 |
| G. E.-Fleming | 200 | 220 | 60 |
| G. E.-Fleming | 240 | 2300 | 60 |
| Westghse.-Fleming | 250 | 440 | 60 |
| Allis-Fleming | 300 | 2300 | 25 |
| G. E.-Ball | 300 | 2300 | 60 |
| G. E.-Ball | 400 | 2300 | 60 |
| Allis-Corliss | 500 | 440 | 25 |
| G. E.-Allis | 600 | 2300 | 60 |
| G. E.-Allis | 800 | 2300 | 60 |
| G. E.-McIntosh | 2000 | 2300 | 60 |

**ALTERNATING CURRENT MOTORS**

| Make | Hp. | Rpm. | Cycles |
|---|---|---|---|
| General Electric | 750 | 514 | 60 |
| General Electric | 750 | 750 | 25 |
| Crocker-Wheeler | 600 | 514 | 60 |
| Westinghouse | 400 | 450 | 60 |
| General Electric | 300 | 500 | 25 |
| General Electric | 275 | 600 | 60 |
| General Electric | 200 | 450 | 60 |
| General Electric | 200 | 500 | 25 |
| General Electric | 150 | 750 | 25 |
| General Electric | 150 | 720 | 60 |
| General Electric | 100 | 715 | 25 |
| Westinghouse | 100 | 720 | 60 |

**A. C. GENERATORS BELTED**

| Make | Kw. | Rpm. | Cycles |
|---|---|---|---|
| Westinghouse | 500 | 300 | 60 |
| Westinghouse | 300 | 514 | 60 |
| Allis | 250 | 600 | 60 |
| General Electric | 200 | 600 | 60 |
| General Electric | 150 | 600 | 60 |
| Westinghouse | 100 | 900 | 60 |
| Westinghouse | 100 | 750 | 25 |
| Crocker-Wheeler | 100 | 277 | 60 |
| General Electric | 75 | 1200 | 60 |
| Crocker-Wheeler | 50 | 300 | 60 |
| Allis | 50 | 1200 | 60 |
| Westinghouse | 50 | 900 | 60 |
| General Electric | 73½ | 1200 | 60 |
| Westinghouse | 30 | 1200 | 60 |

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# MOTORS

## *Immediate Shipment*

**ALTERNATING CURRENT—SLIP RING—60- AND 25-CYCLE**

| *No.* | *Hp.* | *Volts* | *Speed* | *Phase* | *Cycle* | *Make and Type* |
|---|---|---|---|---|---|---|
| 2 | 500 | 2200/440 | 600 | 3 | 60 | Gen. Elec., 3-bearing, Form M |
| 2 | 400 | 2200 | 450 | 3 | 60 | Westinghouse, type CW |
| 1 | 350 | 440/220 | 500 | 3 | 25 | Burke, 3-Bearing |
| 1 | 300 | 440/220 | 600 | 3 | 60 | Gen. Elec., 3-bearing, Form M |
| 2 | 300 | 440/220 | 500 | 3 | 25 | Gen. Elec., 3-bearing, Form M |
| 1 | 250 | 440/220 | 500 | 3 | 25 | Gen. Elec., 3-bearing, Form M |
| 2 | 200 | 2300 | 514 | 3 | 60 | Gen. Elec., 2-bearing, Form M |
| 1 | 200 | 220/440 | 600 | 3 | 60 | Allis-Chal., ANY, 2-bearing |
| 1 | 200 | 220/440 | 500 | 3 | 25 | Gen. Elec., 3-bearing, Form M |
| 1 | 155 | 220/440 | 720 | 3 | 60 | Gen. Elec., 2-bearing, Form M |
| 2 | 150 | 2200 | 514 | 3 | 60 | Gen. Elec., 2-bearing, Form M |
| 1 | 125 | 220 | 720 | 2 | 60 | Gen. Elec., 2-bearing, Form M |
| 1 | 100 | 220/440 | 900 | 3 | 60 | Gen. Elec., 2-bearing, Form M |
| 1 | 100 | 220/440 | 720 | 3 | 60 | Gen. Elec., 2-bearing, Form M |
| 1 | 100 | 220/440 | 900 | 3 | 60 | Gen. Elec., 2-bearing, Form M |
| 1 | 75 | 220/440 | 720 | 3 | 60 | Gen. Elec., 2-bearing, Form M |
| 1 | 75 | 220/440 | 900 | 3 | 60 | Gen. Elec., 2-bearing, Form M |
| 1 | 50 | 220/440 | 900 | 3 | 60 | Gen. Elec., 2-bearing, Form M |
| 1 | 40 | 220 | 850 | 2 | 60 | Westinghouse, HF |
| 1 | 20 | 220/440 | 1200 | 3 | 60 | Gen. Elec., 2-bearing, Form M |

**ALTERNATING CURRENT—SQUIRREL CAGE**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 300 | 2200 | 720 | 3 | 60 | Gen. Elec., 2-bearing, Form K |
| 1 | 300 | 2200 | 600 | 3 | 60 | Gen. Elec., 3-bearing, Form K |
| 1 | 300 | 2200 | 600 | 3 | 60 | Gen. Elec., 2-bearing, Form K |
| 1 | 200 | 440/220 | 1800 | 3 | 60 | Gen. Elec., 2-bearing, Form K |
| 1 | 200 | 2200 | 514 | 3 | 60 | Gen. Elec., 2-bearing, Form L |
| 1 | 150 | 440/220 | 1800 | 3 | 60 | Gen. Elec., 2-bearing, Form K |
| 1 | 150 | 440/220 | 1500 | 3 | 25 | Westg., 2-bearing, Form CCL |
| 3 | 150 | 2200 | 514 | 3 | 60 | Gen. Elec., 2-bearing, Form L |
| 1 | 100 | 440/220 | 720 | 3 | 60 | Gen. Elec., 2-bearing, Form K |
| 1 | 100 | 440/220 | 900 | 3 | 60 | Gen. Elec., 2-bearing, Form K |
| 2 | 75 | 440/220 | 720 | 3 | 60 | Gen. Elec., 2-bearing, Form K |
| 1 | 75 | 440/220 | 900 | 3 | 60 | Gen. Elec., 2-bearing, Form K |
| 3 | 50 | 440/220 | 900 | 3 | 60 | Gen. Elec., 2-bearing, Form K |
| 1 | 50 | 440/220 | 900 | 3 | 60 | Gen. Elec., 2-bearing, Form L |
| 1 | 40 | 440/220 | 750 | 3 | 25 | Burke, 2-bearing, Form EM |
| 1 | 40 | 440/220 | 900 | 3 | 60 | Westg., 2-bearing, Form CS |

| *No.* | *Hp.* | *Volts* | *Speed* | *Phase* | *Cycle* | *Make and Type* |
|---|---|---|---|---|---|---|
| 1 | 40 | 440/220 | 900 | 3 | 60 | Gen. Elec., 2-bearing, Form K |
| 2 | 30 | 440/220 | 600 | 3 | 60 | Gen. Elec., 2-bearing, Form KT |
| 3 | 30 | 440/220 | 1200 | 3 | 60 | Gen. Elec., 2-bearing, Form KT |

*Also complete line of smaller motors.*

**ALTERNATING CURRENT—SYNCHRONOUS**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 300 | 2200 | 450 | 3 | 60 | Gen. Elec., ATI, 2-bearing |
| 1 | 300 | 2200 | 600 | 3 | 60 | Gen. Elec., ATI, 2-bearing |
| 1 | 175 | 440 | 720 | 3 | 60 | Westg., self-starting, 2-bearing |

**DIRECT CURRENT MOTORS—230 VOLTS**

| *No.* | *Hp.* | *Volts* | *Speed* | *Manufacturer's Name and Type* |
|---|---|---|---|---|
| 1 | 250 | 230 | 500 | Sprague-G. E., 2-bearing |
| 1 | 150 | 230 | 550 | Westg.-SK Interpole, 3-bearing |
| 2 | 150 | 230 | 470 | Gen. Elec. "CLB", 2-bearing |
| 1 | 125 | 230 | 445 | Gen. Elec. "CLB", 2-bearing |
| 1 | 110 | 230 | 900 | Gen. Elec. "RC", 2-bearing |
| 1 | 110 | 230 | 650 | Westg. "S", 2-bearing |
| 1 | 75 | 230 | 900 | Gen. Elec. "RC", 2-bearing |
| 1 | 50 | 230 | 610 | Gen. Elec. "CLB", 2-bearing |
| 1 | 25 | 230 | 700 | Westg. "SK", 2-bearing |
| 1 | 15 | 230 | 1100 | Westg. "SK", Interpole |
| 1 | 15 | 230 | 800 r.p.m., | Crocker-Wheeler |

**DIRECT CURRENT MOTORS—115 VOLTS**

| *No.* | *Hp.* | *Volts* | *Speed* | *Manufacturer's Name and Type* |
|---|---|---|---|---|
| 2 | 5½ | 115 | 900 | Gen. Elec., "CVC" Compound |
| 1 | 7½ | 115 | 1700 | Gen. Elec., "RC" Shunt |
| 1 | 10 | 115 | 1700 | Gen. Elec., "RC" Shunt |
| 3 | 15 | 115 | 800 | Gen. Elec., "RC" Shunt |
| 1 | 15 | 115 | 700 | Gen. Elec., "CVC" Compound |
| 1 | 20 | 115 | 900 | Gen. Elec., "RC" Compound |
| 2 | 25 | 115 | 750 | Gen. Elec., "DLC" Compound |
| 1 | 30 | 115 | 750 | Gen. Elec., "RC" Compound |
| 1 | 40 | 115 | 925 | Gen. Elec., "RC" Compound |
| 2 | 50 | 115 | 1075 | Gen. Elec., "RC" Compound |
| 1 | 50 | 115 | 925 | Gen. Elec., "RC" Compound |
| 1 | 60 | 115 | 650 | Gen. Elec., "RC" Shunt |

**Complete stock of smaller motors (both 25 and 60 cycles). Quotations upon request.**

## FREQUENCY CHANGER SET

1—Type ATB, 500-kw., 375-r.p.m., 2300-volt, 3-phase, 60-cycle, form C General Electric Alternator, mounted on the same shaft and common base with
1—ATI, 530-kw., 2300- or 440-volt, 25-cycle, 3-phase General Electric synchronous motor.

## BELTED A. C. GENERATORS

### *Immediate Shipment*

1—312-kw., 2300-volt, 514-r.p.m., 3-phase, 60-cycle, 3-bearing Westinghouse revolving field, complete with belted exciter, etc.
1—312-kva., 240/480-volt, 450-r.p.m., 3-phase, 60-cycle General Electric, type ATB, complete with belted exciter, etc.
1—250-kva., 2300-volt, 3-phase, 60-cycle, 600-r.p.m. General Electric type ATB, form B, revolving field generator, with belted exciter, etc
1—250-kw., 450-r.p.m., 440-volt, 3-phase, 60-cycle General Electric, type ATB revolving field generator, complete with belted exciter.
1—200-kw., 2300-volt, 600-r.p.m., 3-phase, 60-cycle Allis-Chalmers-Bullock Alternator, with direct connected exciter.
1—62-kva., 1200-r.p.m., 2300- or 240-volt, 3-phase, 60 cycle Allis-Chalmers-Bullock Generator, complete.
1—30-kva, 2300-volt (or 240-volt), 1200-r.p.m., 3-phase, 60-cycle Westinghouse revolving field, complete with belted exciter, field rheostat, etc.

## BELTED D. C. GENERATORS

**Complete**

### *Immediate Shipment*

1—450-kw., 300-r.p.m., 250-volt, 8-pole, compound wound C & C complete.
2—200-kw., 720-r.p.m., 240-volt Allis-Chalmers-Bullock, complete.
1—200-kw., 600-r.p.m., 125-volt, compound wound, 6-pole Westinghouse, complete.
2—150-kw., 250-volt, 600-r.p.m., direct current, compound wound, type CL form B Generators, complete.
1—135-kw., 250-volt, 650-r.p.m., direct current, compound wound Westinghouse, SK interpole, complete (three bearing).
2—125-kw., 125-volt, 600-r.p.m. Allis-Chalmers-Bullock, complete.
1—100-kw., 125-volt, 750-r.p.m. General Electric, "MP".
1—100-kw., 750-r.p.m., 125/250-volt, direct current, compound wound Westinghouse, type S, 3-wire, with balancing coils, rheostat, etc.
1—75-kw., 125-volt, 975-r.p.m. General Electric, Ft. Wayne, cpd. wound.
1—45-kw., 125-volt, 1150-r.p.m. General Electric, type RC, compound wound interpole.

### Belted D. C. Generators—*Continued*

1—40-kw., 125-volt, 900-r.p.m. General Electric, compound wound interpole,
1—30-kw., 125-volt, 900-r.p.m. General Electric, belted type DLC, compound interpole.
2—25-kw., 125-volt, 825-r.p.m. General Electric, belted type DLC, compound wound, interpole.
1—20-kw., 250-volt, 900-r.p.m., direct current, compound wound Westinghouse, type SK, interpole, complete.

## MOTOR GENERATOR SETS

1—200-kw., 250-volt, 600-r.p.m., 6-pole, compound wound Westinghouse, D.C. Generator, direct connected with 300-hp., 2300-volt, 600-r.p.m., 3-phase, 60-cycle Westinghouse, self-starting revolving field synchronous motor with starting apparatus.
1—200-kw., 125-volt, 600-r.p.m., 6-pole, compound wound Westinghouse, D.C. Generator, direct connected to 300-hp., 2200-volt or 440-volt, 3-phase, 60-cycle ATI General Electric, synchronous, self-starting Motor, 600-r.p.m., complete.
1—150-kw., 600-r.p.m., 250-volt, 6-pole, compound wound General Electric, type MP Generator, direct connected to 250-hp., 2300-volt, 600-r.p.m., 3-phase, 60-cycle, revolving field synchronous motor, with starting apparatus.
1—135-kw., 720-r.p.m., 250-volt, direct current, compound wound, interpole Westinghouse, type SK Generator, complete with field rheostat and direct connected to 140 Kva., 720-r.p.m., 2200-volt (or 440-volt), 3-phase, 60-cycle Westinghouse, revolving field, self-starting synchronous motor with starting apparatus.
1—125-kw., 125-volt, 580-r.p.m., 6-pole Allis-Chalmers-Bullock Generator, direct connected to 185-hp., 440 or 2300-volt Western Electric, sq. cage Induction motor, complete.
1—100-kw., 125/250-volt, 720-r.p.m., direct current, compound wound Westinghouse, type S, complete with field rheostat and direct connected to 175-hp., 720-r.p.m., 440-volt Westinghouse revolving field type synchronous motor, self-starting, with starting apparatus.
1—75-kw., 125-volt, 1150-r.p.m. General Electric-Ft. Wayne, compound wound, D.C. Generator, direct connected to 100-hp., 220 or 440-volt 3-phase, 60-cycle, 1150-r.p.m. induction motor, complete.
1—75-hp., 220- or 440-volt, 3-phase, 60-cycle, 900-r.p.m., form K induction motor.
1—50-kw., 125-volt, 850-r.p.m. General Electric, compound wound, D.C. Generator, direct connected to
2—40-kw., 125-volt, 1150-r.p.m. General Electric, type RC, direct current generator, compound wound, complete and direct connected to a General Electric, type KT, 3-phase, 220- or 440-volt induction motor.
1—25-kw., 125-volt, 900-r.p.m. General Electric, type DLC, compound wound, direct current Generator, direct connected to 1 General Electric 3-phase, 60-cycle, 220- or 440-volt induction motor

*Apply for quotations on smaller sets.*

# NOTHING BUT GOOD EQUIPMENT

## New and Used—Guaranteed Condition—Ready to Ship

**Slip Rin Motors—3-Phase, 60-Cycle**

| Hp. | Volt | Speed | Make | Type |
|---|---|---|---|---|
| 250 | 2200 | 600 | General Electric | M |
| 200 | 2200 | 600 | General Electric | M |
| 200 | 220/440 | 600 | General Electric | M |
| 150 | 2200 | 600 | General Electric | M |
| 150 | 220/440 | 600 | General Electric | M |
| 100 | 440/220 | 720 | General Electric | M |
| 100 | 2200 | 720 | General Electric | M |
| 100 | 440/220 | 900 | General Electric | MT |
| 100 | 2200 | 600 | General Electric | M |
| 75 | 220/440 | 720 | General Electric | M |
| 75 | 440/220 | 900 | General Electric | MT |
| 60 | 220/440 | 1200 | General Electric | M |
| 60 | 2200 | 900 | General Electric | MT |
| 60 | 440/220 | 900 | General Electric | MT |
| 50 | 550 | 900 | General Electric | MT |
| 50 | 440/220 | 1200 | General Electric | MT |
| 50 | 440/220 | 900 | Allis-Chalmers | ANY |
| 50 | 220/440 | 900 | General Electric | MT |
| 50 | 2200 | 900 | General Electric | M |
| 50 | 2200 | 600 | General Electric | MT |
| 40 | 440/220 | 900 | Allis-Chalmers | ANY |
| 40 | 2200 | 900 | General Electric | MT |
| 40 | 440/220 | 1200 | General Electric | MT |
| 35 | 440/220 | 900 | Allis-Chalmers | ANY |
| 35 | 440/220 | 900 | General Electric | M |
| 30 | 440/220 | 900 | Allis-Chalmers | ANY |
| 15 | 440/220 | 1200 | General Electric | M |

**Squirrel Cage—3-Phase, 60-Cycle**

| | | | | |
|---|---|---|---|---|
| 100 | 440/220 | 900 | General Electric | K |
| 100 | 440/220 | 720 | General Electric | K |
| 75 | 440/220 | 900 | General Electric | KT |
| 50 | 440/220 | 1200 | General Electric | KT |
| 50 | 440/220 | 900 | General Electric | KT |
| 40 | 220/440 | 1200 | General Electric | KT |
| 35 | 220/440 | 900 | Westinghouse | CS |
| 25 | 440/220 | 600 | General Electric | KT |
| 25 | 440/220 | 900 | General Electric | L |
| 25 | 440/220 | 600 | Allis-Chalmers | AN |
| 25 | 220/440 | 1200 | General Electric | KT |
| 25 | 440/220 | 1200 | Westinghouse | CS |
| 20 | 440/220 | 1200 | General Electric | L |
| 15 | 440/220 | 1200 | General Electric | L |
| 10 | 440/220 | 1200 | General Electric | L |
| 10 | 220/440 | 1200 | Allis-Chalmers | AN |

**3-Phase, 25-Cycle**

| Hp. | Volt | Speed | Make | Type |
|---|---|---|---|---|
| 300 | 440 | 500 | General Electric, sl. rg. | |
| 200 | 440 | 500 | General Electric, sl. rg. | |
| 100 | 440 | 750 | Westinghouse, sq. cage | |
| 50 | 440 | 500 | General Electric, sq. cg. | |

**Direct Current Motors**

| | | | | |
|---|---|---|---|---|
| 120 | 230 | 720 | Westinghouse | SK |
| 100 | 230 | 600 | General Electric | RC |
| 100 | 230 | 950 | General Electric | RC |
| 100 | 230 | 1150 | General Electric | RC |
| 90 | 230 | 500 | General Electric | CL-A |
| 75 | 230 | 1150 | General Electric | RC |
| 75 | 230 | 950 | General Electric | RC |
| 75 | 230 | 1100 | Westinghouse | S |
| 30 | 230 | 700 | Sprague | D |
| 20 | 230 | 775 | Crocker-Wheeler | I |
| 10 | 230 | 1150 | General Electric | RC |
| 5 | 115 | 1150 | General Electric | RC |

**DIRECT CURRENT GENERATORS**

1—100-kw., 250/125-volt, 580-r.p.m., compound-wound, 3-wire Westinghouse Generator.

1—100 Kw., 250 volt, 900 r.p.m., compound wound Westinghouse SK D.C Interpole Generator, complete.

1—90-kw., 250-volt, 1100-r.p.m., compound wound interpole, type RC, General Electric Generator, complete.

1—70-kw., 250-volt, 1100-r.p.m., compound wound, interpole, type RC, General Electric Generator, complete.

1—33-kw., 125-volt, 725-r.p.m., compound wound, Sprague Generator, complete.

1—17-kw., 125-volt, 1125-r.p.m., compound wound Westinghouse, type S, Generator, complete.

1—17-kw., 250-volt, 1125-r.p.m., compound wound Westinghouse type S Generator, complete.

**MOTOR GENERATOR SETS**

1—100-kw., 250/125-volt, 580-r.p.m., compound wound Westinghouse, 3-wire, D.C. Generator, coupled by flexible coupling to 150-hp., 2200-440-220-volt, 3-phase, 60-cycle General Electric motor, complete with rheostat and starting apparatus.

1—65-kw., 125-volt, 690-r.p.m., compound wound Westinghouse type SA interpole, D.C. Generator, coupled by flexible coupling to 100 hp., 440-220-volt, 3-phase, 60-cycle G. E. squirrel cage motor, complete.

1—17-kw., 125-volt, 1150-r.p.m., compound wound Westinghouse type S, D.C.Generator, coupled by flexible coupling to 25-hp., 220/440-volt, 3-phase, 60-cycle General Electric, squirrel cage motor, complete.

1—17-kw., 250-volt, 1150-r.p.m., compound wound Westinghouse, type S, D.C. Generator, coupled by flexible coupling to 25-hp., 220/440-volt, 3-phase, 60-cycle General Electric, squirrel cage motor, complete with rheostat and starting compensator.

2—9-kw., 125-volt, 1750-r.p.m. Westinghouse, type SK, D.C. Generator, mounted on base with and coupled to 14-hp., 220/440-volt, 3-phase, 60-cycle Westinghouse, C.S., squirrel cage motor, complete with rheostat and starting compensator.

**Alternating Current Generators**

1—200-kw. Westinghouse, 2300-volt, 600-r.p.m., 3- or 2-phase, 60-cycle revolving field Generator, complete with base, pulley and belted exciter.

1—60-kw. General Electric, 2300-volt, 1200-r.p.m. 3-phase, 60-cycle, revolving field Generator, complete with direct connected exciter, base, pulley and rheostat.

1—50-kva. Westinghouse, 480/240-volt, 1200-r.p.m., 3-phase, 60-cycle, revolving field Generator, complete with belted exciter, base, pulleys and rheostats.

### SPECIAL OFFERING

1—400-kw. Westinghouse, 3-phase, 60-cycle, 2300/480/240-volt, 139-r.p.m., A.C. Generator, direct connected to 31 x 27 Ball-Wood, simple 4-valve, non-releasing, double eccentric heavy duty engine.

1—160-kw., 250-volt, 230-r.p.m. General Electric, type MP, form L, direct current Generator, direct connected to 17 x 16 Harrisburg Standard side crank engine.

1—150-kw., 250-volt, 225-r.p.m. General Electric, form RB, direct current Generator, direct connected to 16 x 18 Harrisburg side crank left-hand engine.

*We also have a number of other desirable Engine Generator Sets—both A.C. and D.C. and a large stock of 2-phase Motors.*

**STEPHEN HALL & CO., Inc., 90 West St., New York** TELEPHONES: Rector—3891, 3892, 3893

# INDEPENDENT ELECTRIC MACHINERY CO.

## CENTRAL STREET and GOODRICH PLACE, KANSAS CITY, MO.

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### All Apparatus Listed Below in Stock for Prompt Shipment

**3-PH., 60-CY., 220-VOLT MOTORS**

| No. | Hp. | Make | Speed |
|---|---|---|---|
| 1 | 20 | Westg., 2200-volt, Rebuilt.. | 870 |
| 4 | 20 | Robbins & Myers, New.... | 1750 |
| 2 | 25 | Allis-Chalmers, Rebuilt.... | 1200 |
| 1 | 25 | Robbins & Myers, New.... | 1750 |
| 3 | 25 | Robbins & Myers, New.... | 1150 |
| 3 | 25 | Robbins & Myers, New.... | 850 |
| 1 | 25 | Lincoln, slip ring, 2200-v.. | 1200 |
| 3 | 30 | Allis-Chalmers, Rebuilt.... | 860 |
| 1 | 30 | G. E., slip ring, New..... | 900 |
| 3 | 30 | G. E., Rebuilt..... | 1200 |
| 1 | 30 | W. E., S.R.,Rebuilt,2200-v. | 350 |
| 1 | 30 | Westg., 2200-volt, Rebuilt.. | 1120 |
| 1 | 35 | Wagner, Rebuilt..... | 1730 |
| 7 | 40 | Watson, Rebuilt..... | 1200 |
| 1 | 40 | Allis-Chalmers, Rebuilt.... | 865 |
| 5 | 40 | Watson, New..... | 1200 |
| 1 | 50 | G. E., slip ring, New..... | 1200 |
| 1 | 50 | Allis-Chalmers, Re.,2200-v. | 865 |
| 1 | 75 | Allis-Chalmers, Rebuilt.... | 900 |
| 1 | 150 | G. E., slip ring, Rebuilt.... | 695 |

**3-PH., 60-CY., ALTERNATORS**

1—25-kva., 120-volt, 3-phase, 60-cycle, self-excited Alternator, Ft. Wayne.

1—50-kva., 2300-volt, 1200-r.p.m. Fairbanks-Morse, belted Generator, with exciter, complete.

1—50-kw., 220-volt, 60-cycle, 3-phase, 3600-r.p.m. Burke Alternator, direct connected to 50-kw. turbine, complete.

1—60-kva. 2300-volt, 900-r.p.m. Elect. Mchy. Revolving Field Belted Generator, with exciter, complete.

1—62-kw., 2200-volt, 60-cycle, 3-phase, 300-r.p.m. Bullock Alternator, direct connected to an Almes steam engine, all complete.

1—80-kva., 2300-volt, 60-cycle, 3-phase, 225-r.p.m. Ft. Wayne Alternator, direct connected to 110-hp. Buckeye producer gas engine, complete.

1—100-kva., 2300-volt, 900-r.p.m. General Electric self-excited Generator.

1—100-kva. Western Electric, 900-r.p.m. Revolving Field.

1—100-kva., 2300-volt, 2-phase Allis-Chalmers high-speed turbo Generator, direct connected to Kerr non-condensing steam turbine, direct connected exciter.

1—100-kva., 2300-volt, 277-r.p.m. Westinghouse Generator, direct connected to 125-hp. Erie Steam Engine.

2—100-kw., 440-volt, 60-cycle, 3-phase, 3600-r.p.m. General Electric Curtiss type turbines, complete with jet condensers for each machine, driven by steam pumps, two synchronous motor generator exciter sets, one Curtiss turbine exciter set, all complete with necessary rheostats and nine-panel switchboard.

1—150-kva., 2300-volt, 3-phase, 60-cycle, 720-r.p.m. Electric Machinery Co. Alternator, complete.

**220-VOLT, D.C. GENERATORS**

| Kw. | Make | Speed |
|---|---|---|
| 1 50 | Fairbanks-Morse..... | 850 |
| 1 60 | Commercial..... | 700 |
| 1 75 | Fairbanks-Morse..... | 750 |
| 1 80 | Thompson-Ryan..... | 600 |

**110-VOLT D.C. GENERATORS**

| | | |
|---|---|---|
| 1 17½ | Westinghouse..... | 1125 |
| 1 22½ | Westinghouse..... | 700 |
| 1 30 | Fairbanks-Morse..... | 950 |
| 1 50 | Westinghouse..... | 850 |
| 1 75 | W. E., engine type..... | 275 |

**220-VOLT, D.C. MOTORS**

| | Hp. | Make | Speed |
|---|---|---|---|
| 2 | 30 | G. E. (vertical)..... | 1500 |
| 1 | 35 | Westinghouse..... | 1420 |
| 1 | 35 | Crocker-Wheeler..... | 750 |
| 1 | 75 | Westinghouse..... | 450 |
| 1 | 110 | Crocker-Wheeler..... | 560 |

**DIRECT CONNECTED SETS**

1—25-kw. General Electric, 250-volt Generator, compound, 3600-r.p.m., direct connected to Curtis steam turbine.

1—30-kw., 220-volt, 300-r.p.m. Sprague Generator, direct connected to 10 x 10 Ideal steam engine.

1—75-kw., 285-r.p.m., comp. Westinghouse Generator, direct connected to 10 x 12 Ideal steam engine.

1—100-kw., 220-volt, 400-amp., 250-r.p.m., 3-wire Western Electric Generator, direct connected to a Fitchburg tandem steam engine.

1—100-kw., 220-volt Westinghouse, comp. Generator, 255-r.p.m., direct connected to 11 x 14 x 20 Ideal steam engine.

2—150-kw., 220-volt, 150-r.p.m. Western Electric Generator, direct connected to Fitchburg tandem compound steam engine.

1—400-kw., 220-volt Western Electric comp. Generator, 140-r.p.m., direct connected to 18 x 28 x 30 Fitchburg tandem compound steam engine.

**MOTOR GENERATOR SETS**

1—22½-kw., 115-volt, 850-r.p.m., shunt Allis-Chalmers Generator, direct connected to 33½-hp., 3-phase, 60-cycle, 220-volt Allis-Chalmers motor.

1—Ellington Converter, 3-hp., 220-volt, 1-phase, 60-cycle Motor, generates 100-volt, 15-amp.

1—2½-kw. Roth Generator, 55-volt, 50-amp., shunt, direct connected to 5-hp., 1-phase, 60-cycle Wagner Motor.

1—2-kw., 220-volt Crocker-Wheeler Generator, direct connected to 3-hp., 500-volt Motor.

1—3-kw. Peerless Generator, 125-volt, 24-amp., 1750-r.p.m., direct connected to 3-hp., 3-phase, 60-cycle, 220-volt Robbins & Myers Motor.

1—2½-kw. Roth Generator, 52-volt, 50-amp., direct connected to 3½-hp., 1-phase, 60-cycle Century Motor.

1—5-kw. Detroit Converter, 1-phase, 60-cycle, 220-volt, A.C. to 115-volt, 45-amp., D.C.

1—5-kw. Balancer Set, consisting of two 5-kw., C.-W., 125-volt, 1500-r.p.m. comp. Generators.

1—10-kw., 240-volt, W. E. Generator, direct connected to 15-hp., 3-phase, 60-cycle, 220-volt Motor.

1—10-kw. Martin Rotary Converter, 220-volt, 3-phase, 60-cycle to 115-volt, D.C.

1—15-kw., 220-volt, Balancer Set.

1—20-kw., 125-volt, 160-amp., 1200-r.p.m., comp. G. E. Generator, direct connected to 3-phase, 60-cycle G. E. synchronous Motor.

1—25-kw., G. E., 125-volt, comp., 900-r.p.m. Generator, direct connected to G. E., 3-phase, 60-cycle G. E. synchronous Motor.

1—36-kw., 120-volt, 720-r.p.m. Westinghouse Generator, direct connected to 50-hp., 3-phase, 25-cycle Westinghouse motor.

1—40-kw., 80- or 160-volt Westinghouse Generator, direct connected to 60-hp. Westinghouse, 3-phase motor.

IN STOCK
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*Prompt*
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MAC GOVERN & COMPANY INC. POWER MACHINERY

114 Liberty St. New York, N. Y.

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*Shipment*

# TURBINES

***1—4000 Kw.*** **(80% P.F.) Westinghouse-Parsons Horizontal Turbo-Generator, 3-phase, 60 cycle, 2400 volts, 3600 R.P.M., condensing.**

***1—3500 Kw.*** **(80% P.F.) General Electric-Curtis Horizontal Turbo-Generator, 3-phase, 60 cycle, 2300 volts, 3600 R.P.M., condensing.**

***1—1200 Kw.*** **(80% P.F.) Allis-Chalmers Horizontal Turbo-Generator, 3-phase, 60 cycle, 480 volts, 3600 R.P.M., non-condensing.**

***1—1000 Kw.*** **(80% P.F.) Westinghouse-Parsons Horizontal Turbo-Generator, 3-phase, 60 cycle, 2300 volts, 3600 R.P.M., mixed pressure, condensing.**

***1—1000 Kw.*** **(80% P.F.) Westinghouse-Parsons Horizontal Turbo-Generator, 3-phase, 60 cycle, 2300 volts, 1800 R.P.M., condensing.**

***1—600 Kw.*** **(80% P.F.) General Electric-Curtis Horizontal Turbo-Generator, 3-phase, 60 cycle, 3600 R.P.M., mixed pressure, condensing.**

***1—200 Kw.*** **(80% P.F.) Westinghouse-Parsons Horizontal Turbo-Generator, 3-phase, 60 cycle, 2300 volts, 3600 R.P.M., condensing.**

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# JOHN A. STEWART ELECTRIC CO.

**S. W. Corner Water & Vine Sts., Cincinnati, Ohio**

**1814 Continental Bank Bldg., Chicago, Ill.** **2112 Central Street, Kansas City, Mo.**

## MOTORS

1—1400 hp. Westinghouse Type C.W. Slip-ring Rolling-mill type Motor, 3-ph., 60-cy., 2300 volts, 505 r.p.m., with magnetic control panel complete. This motor is brand new and in original crate.

1—1250 kva. Westinghouse Synchronous, 6600 volts, 3-ph., 25-cy., 450 r.p.m., with starting motor.

1—750 hp. New Allis-Chalmers, 3-ph., 60-cy., 2200 volts, slip-ring, 505 r.p.m., with starter.

1—300 hp. New Allis-Chalmers, 3-ph.,25-cy., 440 volts, 485 r.p.m., slip-ring induction type, with drum control.

1—250 hp. New G. E., 3-ph., 60-cy., 550 volts, 600 r.p.m., squirrel cage, 40°.

1—200 hp. General Electric, 3-ph., 60-cy., 2200 volts, 1760 r.p.m., slip-ring motor, with starter.

1—250 hp. Allis-Chalmers, brand new, 3-ph., 60-cy., 2200 volts, 514 r.p.m., slip-ring induction motor, with Westinghouse primary, Cutler-Hammer secondary starter.

1—250 hp. Allis-Chalmers, 3-ph., 60-cy., 2200 volts, 870 r.p.m. slip-ring induction motor, with Westinghouse primary and Cutler-Hammer secondary starter.

2—150 hp. Allis-Chalmers, 3-ph., 60-cy., 440 volts, 865 r.p.m. squirrel-cage motors, with starters.

1—250 hp. Burke, 2 or 3-ph., 60-cy., 2300 volts, 600 r.p.m., synchronous motor, with direct-connected exciter and starting panel.

200 Motors, ranging from 7½ to 75 hp., 3-ph., 60-cy., 550 volts, 40-degree motors, with controllers, at prices which will enable dealers with rebuilding-shop facilities to purchase, rebuild and sell at a profit. Detailer lists mailed upon request.

## TURBINES

3—500 kw. Gen. Elec. Vertical, 3-ph., 60-cy., 1800 r.p.m., 2300 volts, with 2000 sq. ft. surface condenser, with piping to headers. Beautiful condition. Immediate delivery.

2—400 kw. Westinghouse Bronze Bladed, 2 or 3-ph., 60-cy., 3300-2300-550-480 volts, 3600 r.p.m., condensing with 2500 sq. ft. surface condenser.

## FREQUENCY CHANGERS

1—200 kw. G. E., 3-ph., 25-cy., 6000 volts, to 3-ph., 60-cy., 2400 volts, 750 r.p.m., four bearing; can be separated, making 2 motors.

1—400 kw. G. E., same as above, 375 r.p.m.

1—500 kw. G. E., same as above, 375 r.p.m.

## CONDENSERS

2—Westinghouse No. 11 Le Blanc Low-level Jet Condensers, complete with motor-driven pumps, strainers and piping. Used one year and now in perfect condition. Good as new. Immediate delivery Cincinnati.

## GENERATOR AND ENGINE

1—240 kw. Ft. Wayne, 3-ph., 60-cy., 2300 volts, 150 r.p.m., revolving field with belted exciter, direct connected to 13 x 27 x 24 Russel tandem compound 4-valve heavy-duty engine. Excellent condition. Immediate shipment Cincinnati.

## MOTOR GENERATOR SETS

*Immediate Delivery*

**Installed Brand New—Never Operated**

2—2140 kw. Allis-Chalmers 275-volt Direct-current Generator, direct connected to synchronous motor, 3-ph., 25-cy., 12,000 volts, with 300 kw. 275-volt (D.C.) 3-ph., 25-cy. Rotary Converter (used as exciter) and complete switchboard equipment.

## BOILERS

2—480 hp. Sterling Water Tube, code built, 160-lb. working pressure, hand-fired grates, complete with all fittings.

6—500 hp. Aultman & Taylor, B. & W. Boilers, with Green chain-grate stokers; 200-lb. pressure.

4—490 hp. Springfield Water-tube, good for 150-lb. pres., complete with Murphy underfeed stokers and all fittings; excellent condition; immediate delivery; low in price.

20—250 hp. Wickes, with stokers and all fittings; excellent condition. These boilers can go into Michigan or any other State.

## ROTARY CONVERTER

1—500 kw. Westinghouse, 2300 volts A.C., 250 volts D.C., with transformers and switchboard panels; fine condition. Immediate shipment.

1—300 kw. Westinghouse, 60-cy., 3-ph., 11,000 volts A.C., 550 volts D.C., with transformers, A.C. and D.C. panels. Other transformers available for different ratios.

1—400 kw. G. E., 250 volts D.C., 185 volts A.C., 375 r.p.m.; no transformers.

1—500 kw. G. E. Same as above.

## *Announcing Electrical Repair Service*

**We have just opened a large shop fully equipped to take care of smallest to largest electrical repair work. We solicit your inquiries. Railroad switch in building reduces handling charge.**

# J. L. HEMPHILL & COMPANY, Inc.

*Electrical Engineering and Equipment*

**1118-1120 Clinton St., HOBOKEN, N. J.** Tel:— Hob. 447-3618

## APPARATUS IN STOCK FOR IMMEDIATE DELIVERY

### A. C. MOTORS

| No. | Hp. | Volts | Speed | Ph. | Cy. | Make and Type |
|---|---|---|---|---|---|---|
| 1 | 350 | 2200/440 | 600 | 3 | 60 | G. E., syn. motor or condenser |
| 2 | 200 | 220/440 | 900 | 3 | 60 | General Electric, form L |
| 2 | 150 | 220/440 | 900 | 3 | 60 | General Electric, form L |
| 1 | 150 | 2200 | 900 | 3 | 60 | G. E. syn. motor |
| 2 | 100 | 220/440 | 720 | 3 | 60 | General Electric, squir. cage |
| 3 | 75 | 220/440 | 900 | 3 | 60 | Allis-Chalmers, slip ring |
| 3 | 75 | 220/440 | 720 | 3 | 60 | General Electric, squir. cage |
| 1 | 60 | 220/440 | 300 | 3 | 60 | Westinghouse, slip ring |
| 1 | 60 | 2200 | 900 | 3 | 60 | Westinghouse, squirrel cage |
| 2 | 50 | 220/440 | 900 | 3 | 60 | Westinghouse, squir. cage |
| 1 | 50 | 2200/440 | 750 | 3 | 60 | Crocker-Wheeler, squirrel cage |
| 1 | 35 | 220/440 | 900 | 3 | 60 | Westinghouse, squir cage |
| 1 | 25 | 220/440 | 1200 | 3 | 60 | Westinghouse squir. cage |
| 1 | 15 | 220/440 | 1200 | 3 | 60 | Westinghouse squir. cage |
| 1 | 10 | 220/440 | 1800 | 3 | 60 | Westinghouse |
| 1 | 7½ | 220/440 | 1800 | 3 | 60 | General Electric |
| 1 | 5 | 220/440 | 1800 | 3 | 60 | General Electric |
| 1 | 2 | 220/440 | 1800 | 3 | 60 | General Electric |

**SMALLER MOTORS ON REQUEST**

### D. C. MOTORS

| | | | | | |
|---|---|---|---|---|---|
| 1 | 350 | 250 | 480 | DC | Westinghouse |
| 1 | 275 | 250 | 500 | DC | Westinghouse |
| 1 | 100 | 800 | 250 | CL | General Electric |
| 1 | 75 | 500 | 575 | DC | General Electric, CL |
| 4 | 50 | 250 | 1250 | DC | Shunt wound |
| 1 | 40 | 250 | 875 | DC | Westinghouse |
| 1 | 35 | 230 | 750/1500 | | Allis-Chalmers |
| 4 | 25 | 250 | 775 | DC | Allis-Chalmers |
| 3 | 25 | 500 | 600/1200 | | Allis-Chalmers |
| 4 | 25 | 250 | 600/1200 | | Allis-Chalmers |
| 2 | 20 | 250 | 810 | DC | Allis-Chalmers |
| 4 | 20 | 125 | 650 | DC | Shunt wound |
| 4 | 15 | 250 | 800 | DC | Allis-Chalmers |
| 1 | 15 | 250 | 1250 | DC | Allis-Chalmers |
| 1 | 10 | 250 | 1200 | DC | Allis-Chalmers |
| 4 | 10 | 250 | 275/1575 | DC | Variable speed |
| 1 | 7½ | 125 | 1100 | DC | General Electric |
| 1 | 5 | 125 | 700 | DC | Diehl |
| 1 | 3 | 125 | 1100 | DC | General Electric |

### A. C. GENERATORS

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 300 | 220/440 | 900 | 3 | 60 | General Electric |
| 1 | 250 | 220/440 | 600 | 3 | 40 | General Electric |
| 1 | 200 | 2300 | 600 | 3 | 60 | General Electric |
| 1 | 200 | 220/440 | 600 | 3 | 60 | General Electric |
| 1 | 175 | 220/440 | 375 | 3 | 25 | General Electric |
| 1 | 100 | 900 | 2300 | 3 | 60 | General Electric |

### D. C. GENERATORS

| | | | | | |
|---|---|---|---|---|---|
| 1 | 250 | 250 | 590 | DC | Westinghouse |
| 1 | 200 | 250 | 575 | DC | Westinghouse |
| 2 | 125 | 125 | 280 | DC | Westinghouse |
| 1 | 100 | 125 | 290 | DC | Westinghouse |
| 1 | 75 | 900 | 250 | CL | General Electric |
| 1 | 35 | 250 | 1000 | DC | Westinghouse |
| 2 | 15 | 125 | 900 | DC | Shunt wound |
| 2 | 15 | 250 | 900 | DC | Allis-Chalmers |

### MOTOR GENERATOR SETS

1—200-kw., 600-r.p.m., 250-volt Westinghouse Generator, 350-hp. 600-r.p.m., 440/2300-volt synchronous motor.

1—125-kw., 600-r.p.m., 125/250-volt, 3-wire Westinghouse Generator, 190-hp., 600-r.p.m., 220/440-volt, squirrel cage motor.

1—100-kw. 250-volt, 1200-r.p.m. Westinghouse, direct connected, mounted on same base with 150-hp., 2200/440-v., 3-ph., 60-cy. synchronous motors.

1—75kw. 250-volt General Electric type CL, direct connected to

1—125 hp., 900 r.p.m., 3 phase, 60 cycle, 2200 v. General Electric synchronous motor

10—15 and 20 kw., 125 volt Balancer Sets.
Smaller sets upon request.

### ENGINE GENERATOR SETS—D. C. SETS

1—100-kw. Westinghouse, 125-volt, with 15 x 14 simple Skinner engine, at 290 r.p.m.

2—125-kw. Westinghouse, 125-volt Generators, with 2—16 x 16 simple Harrisburg engines, at 280 r.p.m.

1—120-kw. Westinghouse, 125-volt Generator, with 15 x 15 Straight Line engines at 260 r.p.m.

### A. C. SETS

1—200-kva. Crocker-Wheeler, 3-phase, 60-cycle, 220 or 440-volt Generator, with 14¼ x 23 x 16 Ames tandem compound engine, speed 200 r.p.m., with belted exciter.

1—225-kva. Crocker-Wheeler, 3-phase, 60-cycle, 220/440- or 2300-volt Generator, with 18 x 16 simple Ames (135 lb. steam), speed 200 r.p.m., with belted exciter.

1—Dean of Holyoke Duplex Jet Condenser for 500-hp. engine.
1—Bulkley Duplex Jet Condenser and all equipment for 300-hp. engine.

# MOTORS—Price Talks—Did You Get Our Catalogue and Prices?

***LARGEST STOCK OF ITS KIND IN AMERICA—REAL BARGAINS—ALL GUARANTEED ONE YEAR***

**3-PHASE, 60-CYCLE**

| | Hp | Make | Type | Rpm. | Volts |
|---|---|---|---|---|---|
| | 200 | General Electric | Form L | 720 | 220 |
| | 75 | General Electric | Form L | 720 | 220 |
| New | 60 | General Electric | KT | 1160 | 220 |
| | 50 | Fairbanks-Morse | B | 900 | 220/440 |
| | 50 | Western Electric | ..... | 900 | 220/440 |
| 50 | 50 | General Electric | Form L | 900 | 220/440 |
| | 50 | Allis-Chalmers | ..... | 850 | 2300 |
| New | 40 | Westinghouse | CS | 1200 | 220/440 |
| | 35 | General Electric | I | 600 | 440/220 |
| | 35 | Wagner | BP | 1720 | 220/440 |
| | 35 | General Electric | I | 1800 | 220/440 |
| | 35 | General Electric | I | 900 | 220/440 |
| New | 30 | General Electric | KT | 1200 | 220/440 |
| | 30 | Ideal | A | 1150 | 440/220 |
| | 30 | Fairbanks-Morse | ..... | 1200 | 440/220 |
| | 30 | Allis-Chalmers | ..... | 865 | 550 |
| New | 25 | General Electric | KT | 1200 | 220 |
| New | 25 | General Electric | KT | 900 | 440/220 |

**3-PHASE, 60-CYCLE, SLIP RING**

| | | | | | |
|---|---|---|---|---|---|
| New | 550 | Crocker-Wheeler | ..... | 4170 | 2200 |
| | 400 | Westinghouse | Synchronous | 450 | 2200 |
| | 200 | Can. General Electric | ..... | 600 | 2200 |
| | 100 | General Electric | I | 514 | 440/220 |
| | 75 | General Electric | M | 900 | 2200 |
| New | 50 | General Electric | ..... | 690 | 440/220 |
| | 50 | Burke | EMV | 1200 | 220/440 |
| New | 40 | General Electric | MT | 1200 | 220 |
| | 40 | Crocker-Wheeler | ..... | 1200 | 220/440 |
| New | 30 | General Electric | MT | 720 | 440/220 |
| | 25 | General Electric | MT | 1200 | 220/440 |
| | 25 | General Electric | MT | 1150 | 220/440 |
| New | 20 | General Electric | MT | 1200 | 220/440 |
| | 16 | Westinghouse | HF | 1120 | 550 |
| New | 15 | General Electric | M | 1200 | 440/220 |

**INGLE-PHASE, 60-CYCLE**

| | | | | | |
|---|---|---|---|---|---|
| | 15 | Wagner | BA | 1150 | 110/220 |
| | 15 | Century | RS | 1165 | 110/220 |
| | 15 | General Electric | IS | 1200 | 220 |
| | 10 | General Electric | IS | 1800 | 220 |
| | 7½ | Wagner | BA | 720 | 110/220 |
| New | 7½ | Wagner | TBA | 1165 | 110/220 |
| New | 5 | Wagner | TBA | 1740 | 110/220 |
| New | 3 | General Electric | RI | 900 | 110/220 |
| New | 3 | Wagner | TBA | 1160 | 110/220 |
| New | 3 | Wagner | BA | 1725 | 110/220 |
| New | 2 | Wagner | BA | 1165 | 110/220 |
| New | 1 | Wagner | BA | 1165 | 110/220 |
| New | 1 | Union | ..... | 1750 | 110/220 |

**2-PHASE, 60-CYCLE**

| | Hp. | Make | Type | Speed | Volts |
|---|---|---|---|---|---|
| | 75 | General Electric | KQ | 900 | 220 |
| | 50 | Western Electric | KQ | 900 | 220 |
| | 50 | General Electric | IQ | 900 | 220 |
| | 50 | General Electric | KQ | 900 | 220 |
| | 40 | General Electric | KQ | 1200 | 220 |
| New | 35 | Wagner | BZ | 700 | 220/440 |
| New | 25 | General Electric | KQ | 900 | 220 |
| New | 25 | General Electric | KQ | 1200 | 220 |
| | 20 | Westinghouse | CS | 685 | 220 |
| New | 20 | General Electric | KQ | 900 | 220 |
| | 20 | Western Electric | CS | 1145 | 220 |

**2-PHASE, 60-CYCLE, SLIP RING**

| | | | | | |
|---|---|---|---|---|---|
| New | 200 | Westinghouse | CI | 580 | 220/440 |
| | 200 | Westinghouse | CI | 580 | 220/440 |
| | 133 | General Electric | Synchronous | 900 | 2200 |
| New | 30 | General Electric | MQ | 720 | 220 |

**3-PHASE, 25-CYCLE, SLIP RING**

| | | | | |
|---|---|---|---|---|
| 50 | Westinghouse | MW | 720 | 220/440 |
| 37 | General Electric | ITC | 250 | 220/440 |
| 30 | General Electric | ITC | 500 | 220/440 |
| 7½ | General Electric | MTC | 375 | 220/440 |

**DIRECT CURRENT, 110-125-VOLTS**

| Hp | Make | Type | Speed | Winding |
|---|---|---|---|---|
| 30 | Milwaukee | B | 600 | Comp. |
| 30 | Eddy | Pedestal | 675 | Shunt |
| 25 | Sprague | Lundell | 750 | Shunt |
| 25 | Northern | ..... | 850 | Shunt |
| 25 | Sprague | D | 750 | ..... |
| 20 | Crocker-Wheeler | ..... | 900 | Comp. |
| 20 | General Electric | CQ | 925 | Shunt |

**DIRECT CURRENT, 220-250-VOLTS**

| | | | | |
|---|---|---|---|---|
| 90 | Diehl | ..... | 460 | Shunt |
| 90 | Westinghouse | M | 675 | Comp. |
| 90 | General Electric | CLB | 625 | Comp. |
| 75 | General Electric | Crane | ..... | Series |
| 75 | Diehl | ..... | 340 | Shunt |
| 60 | General Electric | DLC | 425/850 | Shunt |
| 60 | Elwell-Parker | ..... | 650 | Shunt |
| 50 | Crocker-Wheeler | ..... | 625 | Shunt |
| 43 | Sturtevant | MP | 850 | Shunt |
| 35 | Western Electric | GM | 800 | Shunt |

**DIRECT CURRENT, 550-VOLTS**

| | | | | |
|---|---|---|---|---|
| 90 | Crocker-Wheeler | CLM | 690 | Shunt |
| 75 | Westinghouse | SK | 1100 | ..... |
| 50 | General Electric | MP | 550 | Shunt |
| 47 | Westinghouse | SA Interpole | 600 | Comp. |
| 40 | Westinghouse | SA | 615 | Comp. |
| 40 | General Electric | CLB | 900 | Shunt |

# NATHAN KLEIN & CO.

**MOTORS** HOWARD & CENTRE STS., N.Y. **DYNAMOS**

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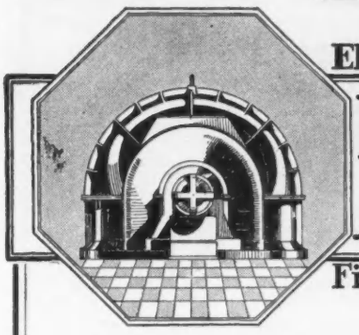
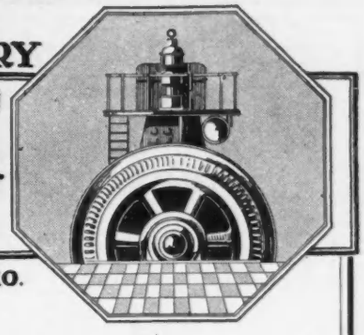


ELECTRIC AND STEAM MACHINERY

# PAUL STEWART AND COMPANY

First National Bank Bldg., Cincinnatti. Ohio.



## Turbo-Alternator Units Available for Early Delivery

### 60 CYCLE

1—10,000 kw. Westinghouse Condensing Unit, 60 cycle, 3 phase, 11,000 volt, 1800 r.p.m. Equipped with LeBlanc Jet Condenser. Motor Driven. Rebladed and practically new. (Delivery 4 Months, Approx.)

1—7200 kw. Westinghouse Condensing Unit, 60 cycle, 3 phase, 2300-4000 volt. Complete with LeBlanc Jet Condenser and all Auxiliaries. (Delivery 3-6 Months, Approx.)

1—5000 kw. General Electric Condensing Turbo-Alternator Unit, 60 cycle, 2 phase, 1200 r.p.m. Complete with Surface Condenser and Steam Driven Auxiliaries. Immediate delivery.

1—5000 kw. Westinghouse Condensing Unit, 60 cycle, 3 phase, 2300 volt, 1800 r.p.m. Complete with LeBlanc Jet Condenser. (Approximately 30 Days delivery.)

1—4000 kw. Allis-Chalmers Condensing Unit, 60 cycle, 3 ph., 2300-4150 volt, 1800 r.p.m. With Surface Condenser. Auxiliaries Steam Driven. (Delivery 3 Months, Approx.)

1—3000 kw. (Actual capacity approximately 4000 k.w.) Westinghouse Condensing Unit, 60 cycle, 3 phase, 2300 or 4400 volt, 1200 r.p.m. With Barometric Condenser.

2—3000 kw. (Actual capacity approximately 4000 kw.) Westinghouse Condensing Unit, 60 cycle, 3 phase, 2300 volt, 1800 r.p.m. Complete with Condensers. (Delivery 6 Months.)

1—3750 k.v.a. Westinghouse LOW PRESSURE, 60 cycle, 3 phase, 11,000 volt, 1800 r.p.m. Unit. Complete with Westinghouse LeBlanc Condenser. Turbine driven. (FALL delivery.)

2—1875 k.w. Westinghouse LOW PRESSURE, 60 cycle, 3 phase, 11,000 volt, 1800 r.p.m. Complete with Westinghouse LeBlanc Jet Condenser, Turbine driven. (Fall Delivery)

1—2000 k.w. (Actual capacity approximately 3000 k.w.) Condensing Unit. 60 cycle, 3 phase, 11,000 volt, 1200 r.p.m. With Alberger Jet Condenser.

1—1500 k.w. Westinghouse Condensing, 60 cycle, 3 phase, 2400 volt, 3600 r.p.m. With LeBlanc Jet Condenser, Turbine Driven. All Auxiliaries.

1—1500 k.w. Westinghouse Condensing Unit. 60 cycle, 3 phase, 2300 volt, 1800 r.p.m. With LeBlanc Condenser.

2—1250-1500 k.w. Westinghouse Condensing or Non-Condensing Units. 60 cycle, 3 phase, 530, 2300 or 11,000 volt, 1200 r.p.m. With LeBlanc Condensers.

1—1000 k.w. Westinghouse Condensing Unit. 60 cycle, 3 phase, 2300 volt, 1800 r.p.m. With LeBlanc Condenser.

4—600 k.w. Westinghouse Non-Condensing. 60 cycle, 2 or 3 phase, 220, 480 or 2400 volt. Newly rewound and rebladed.

2—400 k.w. Westinghouse Condensing, 60 cycle, 2 phase, 2200 volt, 3600 r.p.m. Complete with Surface Condenser.

**A No. 1 APPARATUS IN GOOD CONDITION THE *FIRST* ESSENTIAL**

# Power Plant Equipment

### DIRECT CONNECTED UNITS

1—1800 hp. Cooper cross-compound engine, size 28 x 60 x 60, speed 80 r.p.m., flywheel 18 ft. 60 ton, direct connected to 1200 kw. G. E. 575 volt generator, 16 pole.

1—1800 hp. Cooper cross-compound engine, size 28 x 60 x 60, speed 80 r.p.m. fly wheel 18 ft. 60 ton, direct connected to 1200 kw. G. E. generator, 16 pole, 575 volt.

2—300 hp. Slater cross-compound engines, size 14 x 28 x 36, speed 120 r.p.m., direct connected to two 250-kw. 550 volt Westinghouse 8 pole direct current generators.

2—300 hp. McIntosh & Seymour tandem-compound engines, size 13 x 23 x 22, speed 200 r.p.m., fly wheel 4 ton, 9 ft. diameter, direct connected to two 220 k.w. Walker generators, 550 volt, 8 pole.

1—500 hp. Hamilton-Corliss Simple engine, size 28 x 36, speed 120 r.p.m. 18 ton, 14 ft. 6 in. fly wheel, direct connected to 400 kw. G.E. 550 volt, 8 pole, direct current generator.

2—1500 hp. Pennsylvania Iron Works, cross-compound engines, size 30 x 48 x 48, speed 80 r.p.m., fly wheel 22 ft., 50 ton, direct connected to 850 kw. G. E. 575 volt, 12 pole, direct current generator.

1—750 hp. Greene cross-compound engine, size 20 x 38 x 48, speed 100 r.p.m., direct connected to 525 kw. G. E. 550 volt, 8 pole direct current generator.

1—700 hp. Pennsylvania Iron Works cross-compound engine, size 22 x 40 x 42, speed 90 r.p.m., direct connected to 500 kw. G. E. 550 volt, 10 pole direct current generator.

1—400 hp. Hamilton-Corliss cross-compound engine, size 16 x 30 x 42, speed 100 r.p.m., direct connected to 325 kw. Westinghouse 600 volt, 8 pole, direct current generator.

### BOILERS

3—231 hp. B. & W. water tube boilers, 108-4 in. x 18 ft. tubes.

1—250 hp. B. & W. water tube boilers, 126-4 in. x 18 ft. tubes.

1—250 hp. Cahall boiler, 126-4 in. x 18 ft. tubes.

4—250 hp. National water tube boilers, 150-4 in. x 16 ft. tubes.

1—350 hp. Cahall water tube boiler, 168-4 in. x 18 ft. tubes.

1—400 hp. B. & W. water tube boiler, 196-4 in. x 18 ft. tubes, B. & W. 75 deg. superheater.

1—600 hp. B. & W. water tube boiler, 294-4 in. x 18 ft. tubes, B. & W. 75 deg. superheater.

1—500 hp. Edgemoor boiler, 248-4 in. x 18 ft. tubes, Foster 75 deg. superheater.

3—115 hp. Kendall horizontal return tubular boiler, 114-3 in. x 18 ft. tubes.

2—150 hp. Kendall horizontal return tubular boilers, 140-3 in. x 16 ft. tubes.

2—150 hp. New England Iron Works Co. horizontal return tubular boilers, 132-3 in. x 16 ft. tubes.

1—600 hp. B. & W. water tube boiler, 294-4 in. x 18 ft. tubes

1—250 hp. B. & W. water tube boiler, 126-4 in. x 18 ft. tubes.

2—185 hp. B. & W. water tube boilers, 108-4 in. x 16 ft. tubes.

2—500 hp. B. & W. water tube boilers, 252-4 in. x 18 ft. tubes, 80 deg. B. & W. superheater.

1—500 hp. B. & W. water tube boiler, 252-4 in. x 18 ft. tubes, 50 deg. B. & W. superheater.

3—250 hp. B. & W. water tube boilers, 126-4 in. x 18 ft. tubes.

1—125 hp. Hewey horizontal return tubular boiler.

### ENGINES

2—500 hp. Greene tandem-compound engines for belt drive, size 17 x 33 x 48, speed 104, fly wheels 49 in. face by 16 ft. diameter.

3—500 hp. Hamilton-Corliss tandem-compound engines, size 18 x 34 x 48, speed 72 r.p.m., fly wheels 38 in. face, 22 ft. diameter.

One 700 hp. Cooper cross-compound engine, size 20 x 36 x 48, speed 75 r.p.m., flywheel 49 in. face, 20-ft. diameter.

1—300 hp. Harris Simple engine, size 22 x 48, speed 79 r.p.m., belt wheel 32 in. face, 17 ft. diameter.

1—125 hp. McIntosh & Seymour high speed horizontal engine.

### GENERATORS

2—500 kw. G. E. 550 volt, 350 r.p.m., 4 pole, direct current generators.

3—300 kw. G. E. 550 volt, 400 r.p.m., 4 pole, direct current generator.

1—250 kw. Seamens-Halski, 550 volt, 440 r.p.m., 6 pole, direct current generator.

1—Booster Set, 59 hp., 900 r.p.m., 550 volt, motor, direct connected to 55 kw., 4 pole generator, 200 volt boost.

1—250 kw. Westinghouse 500 volt, 420 r.p.m., 4 pole, direct current generator.

2—45 kw. 110 volt, G. E. direct current generators.

### MISCELLANEOUS EQUIPMENT

Various boiler feed pumps, condensers, piping, coal scales and auxiliary equipment used in connection with the above units.

***Supplanted by Purchased Power***

## EASTERN MASSACHUSETTS ST. RY. CO.

**1 BEACON ST., BOSTON, MASS.**

# 2900

## New G-E Washing Machine Motors

### *for immediate delivery*

All 1/6 hp., 110 volt, single phase, 60 cycle, 1725 r.p.m., Type S.A., Frame No. 145, General Electric, new washing machine motors; semi-enclosed and equipped with double shaft extensions.

These motors are packed in original crates—six motors to each crate.

Price subject to prior sale in lots of 102 motors or more $16.50 net each, f.o.b. New York.

We cannot, considering the high quality and low price of these motors, take orders for extended delivery; all orders accepted will be on basis of immediate shipment.

**STEPHEN HALL & COMPANY, INC.**

TELEPHONES: RECTOR 3891, 3892, 3893 — 90 WEST STREET, NEW YORK, N. Y.

---

## BROWN-HUNKELE CORPORATION

NEWARK, N. J.

### We Have in Stock for Immediate Shipment

4—New, General Electric, 75 hp. vertical, 2 or 3 phase, 60 cycle, 220 or 440 volt, 514 r.p.m. Motors. Complete. We will dispose of cheap to quick buyer.

1—150 hp. General Electric, rebuilt, 720 r.p.m. Motor.

1—100 hp. General Electric, new, 900 r.p.m. Motor.

2—75 hp. General Electric, new, 1200 r.p.m. Motors.

2—50 hp. General Electric, new, 900 r.p.m. Motors.

1—50 hp. Allis-Chalmers, new, 1200 r.p.m. Motor.

2—40 hp. General Electric, new, 1200 r.p.m. Motors.

1—35 hp. General Electric, rebuilt, 1200 r.p.m. Motor.

1—25 hp. Allis-Chalmers, new, 1200 r.p.m. Motor.

2—10 hp. Allis-Chalmers, new, 1200 r.p.m. Motors.

These motors are all slip ring 220 or 440 volt, 2 or 3 phase, 60 cycle with bases, pulleys and drum type controllers.

**We also wish to purchase good used turbo units in eiether A. C. or D. C.**

**Brown-Hunkele Corporation,** NEWARK, N. J.

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### THREE-PHASE 60-CYCLE, 220 VOLT MOTORS

| Hp. | Make | Type | Rpm. |
|---|---|---|---|
| 200 | Crocker-Wh. | | 600 |
| 100 | Allis-Chal. | "AN" | 690 |
| 100 | Westinghouse | "CCL" | 690 |
| 40 | Wagner | "BW" | 850 |
| 30 | Wagner | "BP" | 1170 |
| 40 | Gen. Elec. | Multi-speed | 1200 |
| 30 | Westinghouse | "CCL" | 850 |
| 25 | Wagner | "BP" | 1140 |
| 20 | G. E. | "KT" | 1800 |
| 20 | Crocker-Wh. | | 685 |
| 20 | Crocker-Wh. | | 850 |
| 10 | Westinghouse | "KT" | 1140 |
| 10 | Wagner | Sl. ring | 1140 |
| 10 | West. Elec. | | 1800 |
| 10 | West. Elec. | | 1200 |

### USED MOTORS 110-VOLT D. C.

| Hp. | Make | Type | Rpm. |
|---|---|---|---|
| 30 | Crocker-Wh. | "CCM" | 1000 |
| 15 | Crocker-Wh. | "CCM" | 800 |
| 15 | Bullock | | 1350 |
| 10 | Crocker-Wh. | "CM" | 825 |
| 10 | Crocker-Wh. | "CCM" | 875 |
| 10 | Northern | | 825 |
| 10 | Wood | | 1250 |
| 7½ | Crocker-Wh. | "CM" | 1100 |
| 7½ | Gen. Elec. | "H" | 1800 |
| 7½ | Gen. Elec. | "CE" | 815 |
| 7½ | Diehl | "G" | 950 |
| 5 | Westinghouse | "M" | 1500 |
| 5 | Gen. Elec. | "RC" | 1700 |

### TWO-PHASE, 60-CYCLE 220-VOLT, USED MOTORS

| Hp. | Make | Type | Rpm. |
|---|---|---|---|
| 100 | Allis-Chal. | "AR" | 680 |
| 30 | Fairbanks-M. | Slip rg. | 900 |
| 30 | Fairbanks-M. | Slip rg. | 900 |
| 25 | Westinghouse | "CX" | 1120 |
| 25 | Robbins & M. | "K" | 1150 |
| 20 | Ideal | "A" | 690 |
| 20 | Westinghouse | "C" | 1200 |
| 20 | Westinghouse | "C" | 1200 |
| 10 | Robbins & M. | "K" | 1750 |

### USED MOTORS, 220 VOLT D. C.

| Hp. | Make | Type | Rpm. |
|---|---|---|---|
| 75 | Crocker-Wh. | "CCM" | 650 |
| 55 | Gen. Elec. | "A2" | 800 |
| 40 | Westinghouse | "S" | 985 |
| 30 | Gen. Elec. | "CLB" | 975 |
| 25 | Gen. Elec. | "CLB" | 465 |
| 20 | C and C | | 990 |
| 20 | Bullock | | 1200 |
| 20 | West. Elec. | "IVC" | 925 |
| 15 | Peerless | | 1150 |
| 15 | Fairbanks-M. | | 1250 |
| 13 | Westinghouse | "S" | 875 |
| 12½ | Westinghouse | "S" | 400/1600 |
| 10 | Westinghouse | "S" | 400/1600 |
| 10 | Gen. Elec. | "CQ" | 900 |
| 10 | Gen. Elec. | "CQ" | 800 |
| 10 | Bullock | | 1200 |
| 10 | West. Elec. | "IVC" | 700 |
| 10 | West. Elec. | "IVC" | 700 |
| 10 | Gen. Elec. | | 950 |
| 7½ | Gen. Elec. | "CE" | 1650 |
| 7½ | Crocker-Wh. | "CM" | 1050 |
| 7½ | Crocker-Wh. | "CM" | 875 |
| 7½ | West. Elec. | "CQ" | 825 |
| 7½ | Crocker-Wh. | | 875 |

**Complete stock of new and Used Motors for Immediate Delivery**

**Complete List Mailed on Request.**

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PHILADELPHIA, PA.

# Machinery in Stock for Immediate Shipment

**125-VOLT DIRECT CURRENT DIRECT CONNECTED UNITS**

2—200-kw. Allis-Chalmers, 125 volt, compound wound, 100-r.p.m. Generators, each dir. ctd. to 22 x 36 Allis-Chalmers, heavy duty, double eccentric Corliss engine.
1—125-kw. Westinghouse, 110-volt, 250-r.p.m. Generator, dir. ctd. to 11 and 18 x 16 Ball and Wood non-condensing Engine.
1—60-kw. G. E., 118/120-volt, 280-r.p.m. Generator, dir. ctd. to 12¼ x 14 Watertown horizontal engine.
1—60-kw. G. E., 115/120-volt, 280-r.p.m. Generator, dir. ctd. to 80-hp. Payne engine.
1—30-kw. Sturtevant, 125-volt, 325-r.p.m., 6-pole Generator, dir. ctd. to 9 x 9 Sturtevant vertical engine.
1—30-kw. Westinghouse, 110-volt, 325-r.p.m. Generator, dir. ctd. to 10 x 10 Harrisburg engine.
2—25 kw. Westinghouse, 125 v. generators, dir. ctd. to Westg. auto. 8½ x 8 in. engines.

**250-VOLT DIRECT CURRENT DIRECT CONNECTED UNITS**

1—350-kw. Westinghouse, 125/250-volt, 3-wire, 130-r.p.m. Generator, dir. ctd. to 26 x 30 Porter Allen engine.
1—60-kw. Crocker-Wheeler, 275-r.p.m. Generators, dir. ctd. to 13 x 12 Buffalo Forge horizontal engines.
2—50-kw. Westinghouse, 300-r.p.m. Generators, dir. ctd. to 11 and 19 x 10 Westinghouse engine, 3 wire type.

**550-VOLT GENERATORS**

1—125-kw. Sprague Lundell, 620 r.p.m.
1—100-kw. Westinghouse, 6-pole, 650-r.p.m.
2—100-kw. Westinghouse, 720-r.p.m.

**125-VOLT GENERATORS**

1—200-kw. Westinghouse, 365-r.p.m.
1—200-kw. Bullock, 300 r.p.m.
1—100 kw. G. E. 650 r.p.m.
2—40-kw. Westinghouse, 550-r.p.m.
1—30 kw. Eddy, 900 r.p.m.
1—22½ kw. Westg. 975 r.p.m.
1—14 kw. Gen. Elec., 1425 r.p.m.

**250-VOLT GENERATORS**

1—400-kw. Allis-Chalmers, 415-r.p.m.
1—300-kw. Sprague, 470-r.p.m.
1—150-kw. G. E., 450-r.p.m.

**125-VOLT D.C. MOTORS**

1—90-hp. General Electric CL, 500-r.p.m.
1—25-hp. Triumph, 1100 r.p.m.
1—25 hp. Westg. 850 r.p.m.
1—20-hp. Western Elec., 900 r.p.m.
1—15-hp. General Electric, CE, 690-r.p.m.
1—10-hp. Westinghouse, 1325-r.p.m.

**250-VOLT D. C. MOTORS**

1—80-hp. Gen. Elec. Crane Motor, 490-r.p.m.
1—35-hp. Bullock, 1175-r.p.m.
1—30-hp. Diehl, 725-r.p.m.
1—15-hp. Gen. Elec., type CE, 1100-r.p.m.
1—15-hp. Allis-Chalmers, 1250-r.p.m.
1—7½-hp. C. & C., 1330-r.p.m.

**550-VOLT D.C. MOTORS**

1—65 hp. G. E. 550 r.p.m.
1—30 hp. G. E. 1025 r.p.m.
1—20 hp. Bullock 925 r.p.m.
1—10 hp. Westg. 1300 r.p.m.

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**1100 r.p.m. $45 each**
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1—65-kw., 250-volt, 860-r.p.m., cp.wd. General Electric Generator, direct connected and mounted on common bedplate with 1—220/440-volt, 3-phase, 60-cycle, new Allis-Chalmers induction motor, complete.
1—76-kw., 125/250-volt, 3-wire Western Electric Motor Generator Set, consisting of 2—38-kw., 125-volt Western Electric, D.C. Generators, mounted on common shaft and belted to 1—new Allis-Chalmers, 220/440 volt, 3-phase, 60-cycle induction motor, complete with switchboard.
1—150-kw., 125/250-volt, 1200-r.p.m., cp.wd. Westinghouse Rotary Converter, with transformers for 2200-volt high tension, 3-phase, 60-cycle, 187-volt, low tension with starting taps, complete with starting equipment and switchboard.
1—200-kw., 250/275-volt, 900-r.p.m., cp., wd., Ridgway Generator, connected and mounted on common base with 1—2200-volt, 3-phase, 60-cycle Ridgway synchronous motor, complete.

**ALTERNATING CURRENT MOTORS**
**3 phase, 60 cycle, 40° rating**

| *No.* | *Hp.* | *Rpm.* | *Volts* | *Type* | *Make* |
|---|---|---|---|---|---|
| 8 | 15 | 1200 | 220/440 | AN | Allis-Chalmers |
| 3 | 15 | 900 | 220/440 | A | Ideal |
| 1 | 15 | 900 | 220/440 | CS | Westinghouse |
| 1 | 20 | 1200 | 220/440 | A | Ideal |
| 7 | 20 | 1200 | 220/440 | AN | Allis-Chalmers |
| 3 | 25 | 900 | 220/440 | CS | Westinghouse |
| 2 | 30 | 1745 | 220/440 | HF slip ring | Westinghouse |
| 1 | 30 | 1800 | 220/440 | CCL | Westinghouse |
| 8 | 30 | 1200 | 220/440 | AN | Allis-Chalmers |
| 1 | 30 | 1200 | 220/440 | KT | General Electric |
| 2 | 30 | 1200 | 220/440 | CCL | Westinghouse |
| 2 | 30 | 900 | 220/440 | CS | Westinghouse |
| 1 | 35 | 1800 | 220/440 | I | General Electric |
| 1 | 40 | 1800 | 220/440 | CS | Westinghouse |
| 2 | 40 | 900 | 220/440 | AN | Allis-Chalmers |
| 6 | 50 | 1200 | 220/440 | AN | Allis-Chalmers |
| 1 | 50 | 1200 | 220/440 | BW | Wagner |
| 3 | 50 | 900 | 220/440 | CS | Westinghouse |
| 2 | 75 | 900 | 220/440 | AN | Allis-Chalmers |
| 1 | 50 | 720 | 220/440 | ANY slip ring | Allis-Chalmers |
| 1 | 75 | 720 | 220/440 | AN | Allis-Chalmers |
| 6 | 75 | 600 | 220/440 | Slip ring | Lincoln |
| 2 | 100 | 900 | 220/440 | AN | Allis-Chalmers |
| 3 | 100 | 720 | 220/440 | AN | Allis-Chalmers |
| 1 | 100 | 900 | 220/440 | CW slip ring | Westinghouse |
| 1 | 125 | 720 | 220/440 | CW slip ring | Westinghouse |
| 1 | 150 | 900 | 220/440 | CS | Westinghouse |
| 1 | 150 | 720 | 220/440 | CS | Westinghouse |
| 1 | 200 | 720 | 220/440 | AN | Allis-Chalmers |
| 1 | 200 | 580 | 220/440 | CS | Westinghouse |

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6—325 hp., 1—350 hp., 3—250 hp., 150 lb. pressure.

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2—20 x 42 Hamilton Heavy Duty Corliss Engines. 1—22 x 48 x 48 Hamilton Heavy Duty Cross Compound Engine. 1—11 x 20 Nagle Corliss. 1—20 x 21 Erie City 4-valve Heavy Duty Engine.

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The repair jobs that Nelson Forces do are always satisfying. Experts go anywhere, anytime for any kind of electrical repair work.

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250 kva. Westinghouse 220 volt, 3 phase, 60 cycle 200 RPM. for direct connection or belted.

200 kw. General Electric, 220 volt, 3 phase, 60 cycle, 200 RPM. for direct connection or belted.

100 kw. 125 volt D. C. Western Electric direct connected to a 16 x 16 Automatic Ball Engine, complete, A-1 shape.

2—50 kw., 125 volt D. C. Western Electric direct connected to a 12 x 12 Automatic Ball engine, complete, A-1 shape.

125 kw. Westinghouse A.C. Generator 3 phase, 60 cycle 440 volt direct connected to a compound Buckeye Engine.

1—50 kw. D. C. 3 wire generator with balancing coil and 2 panel switchboard direct connected to a 11 x 11 Side Crank Chuse Engine.

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150 kva. General Electric, type ATB, 3 phase, 60 cycle, 2300 volts, 600 r.p.m.; 100 kva., ATB, 3 phase, 60 cycle, 2300 volts, 900 r.p.m. Both the above machines are complete with base, rails, pulley and switchboard, one 16 in. D.P. leather belt, 68 ft. long, one 14 in. D.P. leather belt 75 ft. long. Price $3000.00 f.o.b. cars Indiana. A-1 condition.

2—15 kva., 3 phase, 60 cycle, 2300 volts, Fairbanks-Morse belted generators.

2—25 hp., type Y, Fairbanks-Morse oil engines, complete with belts and switchboards. Price $2500.00 for the complete plant, f.o.b. cars Iowa.

50 kw. Western Electric 110 volt generator, 700 r.p.m., shunt wound, $600.00, cars Chicago.

28 kw. Western Electric, 125 volt, D.C. generator, 1000 r.p.m. $400.00.

50 hp., 220 volt, shunt wound Jenny motor, 780 r.p.m. $600.00.

50 hp. Fairbanks-Morse, 3 phase, 60 cycle, 220 volt, slip ring, 900 r.p.m., with pressure gauge self-starter. $700.00, cars Chicago.

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**Direct Current Engine Generator Sets**

**BOILERS**

***In mediate delivery. Can be inspected in operation.***

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**A.C. 60-CYCLE UNITS**

| *Kw.* | *Generator* | *Engine* |
|---|---|---|
| 1250 | Westinghouse | Turbine |
| 625 | Westinghouse | Turbine |
| 500 | General Electric | Skinner |
| 500 | General Electric | Allis-Corliss |
| 475 | General Electric | Uniflow |
| 450 | Allis-Chalmers | Vilter Corliss |
| 375 | General Electric | Gen. Elec., Turbine |
| 360 | General Electric | Harris Corliss |
| 300 | Allis-Chalmers | Skinner |
| 300 | Burke | Uniflow |
| 300 | Westinghouse | Ridgway |
| 250 | Allis-Chalmers | Allis-Chalmers |
| 250 | General Electric | McI. & S. |
| 225 | Westinghouse | Fleming, 4-valve |
| 175 | Allis-Chalmers | Allis-Chalmers |
| 150 | Allis-Chalmers | Ideal |
| 125 | General Electric | Erie Ball |
| 120 | General Electric | Hamilton Corliss |
| 100 | Crocker-Wheeler | Ridgway |
| 90 | General Electric | Uniflow |
| 75 | General Electric | Fleming |
| 60 | Elec. Machinery | Skinner |
| 50 | General Electric | Harrisburg |

**230-250-VOLT D.C. UNITS**

| *Kw.* | *Generator* | *Engine* |
|---|---|---|
| 425 | General Electric | 26 x 36 Corliss |
| 400 | Crocker-Wheeler | Bates Corliss |
| 300 | Crocker-Wheeler | Watt Campbell |
| 300 | Westinghouse | 24 x 30 Corliss |
| 250 | Triumph, 3-wire | Skinner |
| 225 | Burke | 22 x 30 Corliss |
| 200 | Westinghouse | Erie Ball |
| 185 | General Electric | Chandler Taylor |
| 150 | Westghse., 3-wire | Vertical compound |
| 150 | General Electric | Turbine |
| 100 | Allis-Chalmers | Skinner |
| 75 | General Electric | Skinner |
| 75 | Westinghouse | Westghse., vertical |
| 75 | Allis-Chalmers | Erie Ball |
| 62½ | General Electric | Ames |
| 35 | Gen. Elec., 3-wire | Harrisburg |
| 25 | Gen. Elec., 3-wire | Troy, vertical |

**110-125-VOLT D.C. UNITS**

| *Kw.* | *Generator* | *Engine* |
|---|---|---|
| 300 | General Electric | Fleming, 4-valve |
| 250 | General Electric | Fleming, 4-valve |
| 200 | General Electric | Fleming, 4-valve |
| 150 | General Electric | Turbine |
| 100 | Westinghouse | Skinner |
| 75 | Crocker-Wheeler | Ames |
| 75 | General Electric | Harrisburg |
| 65 | Burke | Harrisburg |
| 60 | General Electric | Harrisburg |
| 50 | General Electric | Harrisburg |
| 50 | Westinghouse | Skinner |
| 30 | General Electric | Gen. Elec. Marine |
| 30 | General Electric | Ames |
| 20 | Burke | Chandler Taylor |
| 20 | Akron | Harrisburg |
| 15 | Burke | Marine, vertical |
| 10 | General Electric | Gen. Elec. Marine |
| 8 | General Electric | Gen. Elec. Marine |
| 2½ | General Electric | Engberg, marine |

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FOR SALE

Two Woodward Oil Governors.

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3 Phase, 60 Cycles, 2300 Volts, A. C.

1—625 K.V.A. Electric Machinery, 225 R.P.M.

1—250 K.V.A. Allis-Chalmers, 300 R.P.M.

Complete with Exciters, Oil switches, and B.V.M. Switchboard panels, Meters, etc.

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The above mentioned equipment is all in good condition, ready for service; right price for immediate sale. Write for detail description.

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4000 kva. Westinghouse horizontal, condensing Turbo-Generator Unit—3 phase, 60 cycle, 2300 volts, 3600 r.p.m., 200 lb.

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**This unit is new having never been erected and is available for immediate shipment.**

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**NEW AND REBUILT FULL DIESEL TYPE OIL ENGINES**

2—450 b.hp. vert. 6 cyl. coupled to 3 ph., 60 cyc., A.C. generators.
1—450 b.hp. vert. 6 cyl. belted.
2—225 b.hp. vert. 3 cyl. bltd. of cpld.
1—225b.hp. vert. 3 cyl. coupled to 200 kva., 3 ph., 60 cyc., 2300 volt genr.
1—170 b.hp. vert. 3 cyl. belted.
1—120 b.hp. vert. 3 cyl. coupled to 85 kw., 3 ph., 60 cyc., 2300 volt genr.
1—120 b.hp. vert. 3 cyl. coupled or bltd.

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1—60 b.hp. vert. sgl. cyl. 2 cyc. bltd.
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2—25 b.hp. horiz. F.-M. type "Y" bltd

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1—150 b.hp. vert. 3 cyl. coupled to 100 kw., 250 v. D.C. Genr.
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1—150 hp., 500 r.p.m., 440 v., 3 ph., 25 cy., Westinghouse slip ring.
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1—100 hp., 900 r.p.m., 220 v., 3 ph., 60 cy., new General Electric.
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12—50 hp., 900, 1200 and 1800 r.p.m., 3 ph., 60 cy., Allis-Chalmers.
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3—40 hp., 900 and 1200 r.p.m., 3 ph., 60 cy., 220 and 440 volts.

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## NOTICE TO ADVERTISERS

Owing to the holiday, July 4th, the "*Searchlight*" pages of the July 2nd issue will close for press earlier than usual. Copy for this issue should reach us by *Noon, Saturday, June 25th.*

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Can be operated condensing or non-condensing. Capable of 100% overload. Also:

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## 1—625 K.V.A.

3 ph., 60 cy., 2200 V., 3600 r.p.m. Horizontal Westinghouse-Parsons Turbo Generator Set, complete with condenser, pumps and switchboard. Used two years.

*Write-Wire-Phone*

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## Dynamos and Engines

Fairbanks-Morse dynamo, 20 kw. 125 volts, amperage 160, type C.P., No. 22070-K, adjusted 1150 r.p.m.; Fairbanks-Morse dynamo, 10 kw. 125 volts, adjusted 1150 r.p.m., No. 697-H; also 2 Fairbanks-Morse engines, 15 and 25 hp.; All in first class condition.

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1—100 kva. "Crocker-Wheeler" 2400 volts, 60 cycle, 3 phase Generator; direct connected to 15 in. x 14 in. "American Ball" automatic engine. With exciter.

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The Surety Motor Bonding Co. establishes a system of rigid inspection and checking covering the renewing of used motors. Apparatus bearing the license label is guaranteed by the licensees. We guarantee their guarantee and cover it with a Surety Bond underwritten by one of the leading surety companies of the country.

**Surety Motor Bonding Company**

SURETY RENEWED MOTORS BONDED — SURETY MOTORS (BONDED)

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MOTORS SUPPLIES ELECTRICAL CONSTRUCTION

*Authorized General Electric Motor Dealers*

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0230

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10—10-in. Worthington, Class B double suction 8,600 G.P.M. at 152 ft.
4—14-in. Allis-Chalmers Type S. 7,500 G.P.M. at 130 ft.
2—10-in. Allis-Chalmers Type S. 3,750 G.P.M. at 130 ft.
2—8-in. Allis-Chalmers Type S. 1,850 G.P.M. at 150 ft.
3—6-in. A. W. W. 1000 G.P.M. at 125 lbs.

**STEAM DRIVEN CENTRIFUGAL**

6—16-in. Allis-Chalmers Type S. 8,500 G.P.M. at 90 ft.
6—14-in. Allis-Chalmers Type S. 6,500 G.P.M. at 150 ft.

**STEAM DRIVEN HYDRAULIC**

6—14 & 20 x 7½ x 18 Worthington Compound Duplex, 400 G.P.M. at 300 lbs.
10—25 & 38 x 4⅝ x 24 Worthington Tandem Duplex, 150 G.P.M. at 3,600 lbs.
2—20 x 12 x 16 Worthington Duplex Fire Pumps, 1,500 G.P.M.

**BOILER FEED PUMPS**

200—New and used Worthington Boiler Feed Pumps, various sizes.

Write for specifications and prices.

**THE NASHVILLE INDUSTRIAL CORPORATION**
Old Hickory, Tennessee

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FOR SALE

3—Thury **Automatic Regulators** with case complete with regulators and **rheostats.**
1—**Switchboard** with 3 Wattmeters, 2 voltmeter and 1 power factor meter.
1—**Oil Switch** type F2 direct connected, 3 phase, 13,200 volts, 300 ampere.
3—Volta type electric electrode **Winches** with 1 hp. Westinghouse D.C. motors, capacity 6000 lb.
3—Westinghouse self cooled **Transformers,** 650 kva., indoor type; 6600 volt primary, secondary 66 to 90 volts, four taps.
1—Kron automatic **Dormant Scale,** capacity 2000 lb.
1—Toledo automatic **Dormant Scale,** capacity 1200 lbs.

**CHATTANOOGA ELECTRO METALS COMPANY**
Chattanooga, Tenn.

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**For Sale Cheap to Quick Buyer**

## COMPLETE POWER PLANT

Two Boilers, two engines, two Generators, Belts, Feed Pumps, Heaters, etc. First-class condition. Ready for delivery about July 1. Full particulars on request. Only reason for sale is because electric power is being installed. Can be seen in operation.

**Susquehanna Traction Co.**
Lock Haven, Pa.

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FOR SALE

One 150 hp., 440 volt, 3 phase, 25 cycle, 750 r.p.m., G. E.

## Squirrel Cage Motor

with base, pulley and starting compensator. Bought 10 years ago. Used 20 months for stand by service. As good as new. Address,

**DE PERE LIGHT & POWER CO.**
De Pere, Wisconsin

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## PAPER MOTOR PULLEYS

New, all sizes in stock. Shipment made within twenty-four hours.

**CHICAGO ELECTRIC COMPANY**
740 West Van Buren St., Chicago

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# MOTORS New and Rebuilt GENERATORS

## *SPECIALS*

### MOTOR

100 H.P. Roth Interpole, 240 Volt, 850 R.P.M., Direct Current, like new, complete ..... $700.

### GENERATOR

150 K.W. Crocker-Wheeler 550 or 250 Volt, 600 R.P.M. First-class condition, complete ..... $925

*Note:—Can be used as motor*

### TURBO GENERATOR

50 KW. Ft. Wayne G. E. Type Br. Form C 115/230 Volt, 3 Wire, 200 Amps., 3000 R.P.M., Dir. Conn. 75 HP. Kerr Turbine Size 186.

*Complete Switchboard, Instruments, Etc. $1400*

ALSO MOTOR GENERATOR AND DIRECT CONN. ENGINE GENERATOR SETS.

## BELYEA COMPANY

INCORPORATED

145-151 West 18th Street
NEW YORK CITY

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## 200 MOTORS

7½ to 75 hp., 3 ph., 60 cy., 550 V., 40 degree with controllers, in good condition, at prices low enough to re-build for 220 or 440 volts and sell at a profit. Detailed descriptive list mailed upon request.

**John A. Stewart Elec. Co.**
S. W. Cor., Water and Vine Streets
Cincinnati, O.

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## BOUSTEAD ELEC. & MFG. CO.

**Switchboards**

**New and Used Electrical Machinery**

**Winding and Repairing**

**16-18 E. Hennepin Ave.**
**MINNEAPOLIS, MINN.**

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**Electrical Engineers, Electrical Power Equipment and Central Station Repairs, Meters and Transformers.**

**W. N. ALBERTSON & COMPANY**
Milwaukee, Wis.

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**Harris Brothers Co. offers**

**Electrical Equipment**

7—Westinghouse, 250 hp. Motors, Type C. C. L. 440 volt, 60 cycle, 3 phase motors, speed 514 r.p.m., with base and starters. Can be furnished with pulley or flange coupling.

1—250 kw. General Electric Alternating Current Generator, Type ATB, Class 36, Form E, 220-440 volt, 3 phase, 60 cycle, 330 amp., speed 200, No. 66509.

1—210 kw. General Electric Alternating Current Generator, Type ATB, class 36, Form E, 220-440 volt, 3 phase, 60 cycle, 271 amp., speed 200, No. 70924.

*Write for Industrial Bulletin 204*

**HARRIS BROTHERS COMPANY**
35th and Iron Sts., Chicago, Ill.

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**IMMEDIATE DELIVERY**

**60 CY., 3 PH., TURBOS.**

NEW 4900 KVA. 2300 V. WITH COND.
3750 kva. 4400-2200 v. Westg.
1250 kva. 2300 v. hor. Non. Cond.
2—625 kva. 480-240 v. Hor. Cond. 1—Non. Cond.
156 kva. 480-440 v. Non. Cond.
800 kw. 250 v. Dir. Cur. with Cond.
1000 kw. 125-250 v. Dir. Cur. Mixed Press.
1000, 937, 625 kva. 2300, 480 v. Eng. Sets.
1—600 kw. 250 v. Dir. Cur. 26 x 48 Eng. Sets. Price $5000 cars Ind. shipment.
468 hp. NEW Syn. Motor 187 Rev. 25 cy.
NEW 400, 600, 750 HP. 2200 V. MOTORS. All 60 cy. 3 ph. 505 rev. Slip Ring.
350 hp. Heine Boiler 175 lb. and stack.
500 hp. Boiler 200 lb. and Chain Gr. Stkr.

**ROSS POWER EQUIP. CO.**
Indianapolis, Ind.

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## 62 K.v.a. Belted Alternator

1—62 kva., 220/440/2200 Volt, 720 r.p.m., 3 ph., 60 cyc., belted alternator, complete with exciter, base, pulley and switchboard. Unit guaranteed. Price $800.00.

**The Electric Motor & Repair Company**
Akron, Ohio

## For Quick Sale!

***Ready Now***

1—150 hp. Basshor, H. R. T. **Boiler,** equipped with a shaking grate.

2—Mesta Machinery Company simple Corliss **Engines,** 20-in. diameter by 42-in. stroke, 91½ r.p.m., non-condensing, for 125 pound throttle pressure.

2—Westinghouse, 264 kva., 220 volt, 3 phase, 540 r.p.m., belt driven **Generators** or **Synchronous Motors.**

2—Westinghouse 12½ kw. **Exciters,** 125 volt, 1100 r.p.m., arranged for belt connection to the generator shaft.

2—Generator **Switchboards** with necessary switches, field rheostats, meters, pilot lamps, etc.

***Offered Subject to Prior Sale.***

**Consolidated Gas, Electric & Power Co. of Baltimore, Md.**

***For inspection communicate with Industrial Power Department 408 Lexington Building***

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## POWER

**Steam Engines and Turbines**

**Dynamos and Motors in Stock**

***Our erecting engineers will serve you in making installation. Advise requirements.***

**COLEMAN-SHOEMAKER, Inc.**

**COMMERCIAL TRUST BUILDING, PHILADELPHIA.**

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## ELECTRIC PUMPS

5-in. Gould 3-stage Centrifugal Pump, connected to 100 hp., 60 cycle, 3 phase Motor. Capacity 500 gals. at 450 ft. head.

3-in. Lea single-stage Centrifugal Pump, connected to 10 hp., 60 cycle, 3 phase Motor. Capacity 300 gals. at 50 ft. head.

Send for our July list of the largest stock in the United States of slightly used and thoroughly overhauled MACHINE TOOLS, POWER, ELECTRICAL AND CONTRACTORS' EQUIPMENT. Satisfaction Guaranteed or Money Refunded.

**WICKES MACHINERY CO., JERSEY CITY, N. J.**

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## MOTORS

**3-PHASE, 60-CYCLE**

| Hp. | Make | Type | Volt | Rpm. |
|---|---|---|---|---|
| 4— 25 | General Electric | L | 220 | 1200 |
| 2— 25 | Westinghouse | CS | 220 | 720 |
| 3— 25 | Westinghouse | CS | 220 | 900 |
| 1— 30 | Crocker-Wheeler | Sq. Cage | 2200 | 900 |
| 3— 50 | General Electric | L | 220 | 900 |
| 1—100 | General Electric | L | 550 | 720 |
| 1—200 | General Electric | L | 550 | 600 |

## SMALL ALTERNATORS

1—25-kva. Crocker-Wheeler, 1800-r.p.m.
1—50-kva. Wagner, 900-r.p.m.

## CRANE MOTOR

25-hp. Westinghouse, 250-volt, complete controller and grids. Almost new. $275.00.

**Caddy Electrical Equipment Co.**
77 Washington St., North, Boston, Mass.

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FOR SALE

6 Thury Automatic **Regulators,** 3 sets of two in cases, complete with controllers and rheostats.

6 Volta type electric **Winches** with 1 h.p. D.C. Westinghouse motor. Capacity 6000 lb.

1 Willey Generator No. 2171, 250-volt speed. 750 R.P.M. 30 K.W.

1 Westinghouse induction **Motor** 25 h.p., 220 volt, 3 phase 60 cycles.

1 Kron automatic **Dormant Scale,** capacity 1500 lb.

1 Toledo automatic **Dormant Scale,** capacity 10,000 lb.

1 Chicago, 5 stage centrifugal **Pump** direct connected to 7.5 K.W., A.C. motor.

**SOUTHERN FERRO ALLOYS COMPANY**
Chattanooga, Tenn.

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**7—50 H.P. G. E.**

## INDUCTION MOTORS

Type K.P. 343, Form B, 60 cycle, 3 phase, 440 volts, 1200 r.p.m., with starting compensators. Guaranteed in first class condition.

**NEW JERSEY MACHINERY EXCHANGE**
21-23 Mechanic Street, Newark, N. J.

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FOR IMMEDIATE SALE

3—375 kva., 25 cycle, single phase, 6400 primary to 460 secondary volts, air cooled Allis-Chalmers

## TRANSFORMERS

complete with blower and 5 hp. motor. A-1 condition.

**The Parker-Young Company**
Lincoln, N. H.

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## NEW CORLISS ENGINES

27—18 x 36 Heavy Duty, Allis-Chalmers Corliss Engines, both right hand and left hand. 350 H.P. at 125 r.p.m., 11 ft. by 32 inches. Band wheel. Operated on 140 lb. steam pressure, 1½ inch gauge back pressure, double eccentric.

**The Nashville Industrial Corporation**
Old Hickory, Tenn.

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## WANTED

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FOR SALE

One 150 H.P. type C.S. Westinghouse

## INDUCTION MOTOR,

700 R.P.M., 220-V 2-phase, without base, pulley or starting apparatus.

**PEOPLES POWER COMPANY**
125 W. 3rd St., Davenport, Ia.

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FOR SALE

## STRANDED CABLE

1075 ft. No. 6 B & S, 3 conductor, 3/32 in. rubber and tape on each conductor. Conductors stranded together with jute fillers, 5/64 in. lead CLAW finish for 3000 V. service. New Cable on Manufacturer's reel.

**SOUTHERN NEW YORK POWER CO.**
Cooperstown, N. Y.

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WANTED

## D. C. ELECTRIC METERS and METER PANS

All sizes. State quantity and lowest price.

**AUTLER ELECTRIC CO.**
1472 Broadway, New York City

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FOR SALE

Three—Brand new 17 kva. regulating

## TRANSFORMERS

for 2200 volts, 60 cycles, primary and 6.6 amp secondary circuits.

**ELECTRIC MOTORS CORPORATION**
137 Lafayette Street, New York

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## METER BARGAIN

Thomson Switchboard Type. 2-wire, 75-amp., 231-240 volts. Absolutely new. A chance to get a new meter at second-hand cost.

W. A. Hefner, c/o McGraw-Hill Co.
10th Ave. at 36th St., New York City

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We are in the market to purchase one second-hand 300-kw.

## GENERATOR

2300 volts, 3 phase, 60 cycle and engine.

**BEMIDJI MANUFACTURING COMPANY**
(Incorporated)
Bemidji, Minn.

## POSITIONS VACANT

A SUCCESSFUL medium-sized company at present manufacturing electrical machinery, wishes to employ a high-grade man capable of designing induction motors (not fractional horsepower) and familiar with their applications and manufacture. Both experience and initiative are required. The position to be offered is attratctive and permanent. In framing your application, please state in detail the character and extent of your engineering, manufacturing and commercial knowledge in relation to induction motors. P-178, Elec. World.

ELECTRICAL cable splicers, good wages, steady work 8 hrs. per day. P-157, Elec. World, Old Colony Bldg., Chicago.

ELECTRICAL foreman capable of handling men, industrial plant a.c.; 40 miles from New York, steady work, chance of advancement. State experience and salary expected. P-193, Elec. World.

ELECTRICAL estimator wanted—Experienced man, ability to lay out work, by a contractor in Chicago doing electrical wiring in all grades of buildings. State age, experience, technical education and salary desired. P-204, Elec. World, Old Colony Bldg., Chicago.

EXPERIENCED man wanted in meter department. Must be familiar with relay testing, remote control switch, panel wiring and switchboard instrument calibration. None but experienced men need apply. Excellent opportunity for the right man. State salary, experience and furnish references. P-199, Elec. World, Real Estate Trust Bldg., Phila.

EXPERIENCED electrical engineer wanted for superintendent of hydro-electric plants, Southeast. Only engineer having experience in handling men and hydro-electric operation should apply. Must be able to effectively carry on operation and construction embodying re-design of plant. In reply, give age, weight, height, nationality, number and age of children and photograph. Interview can be had in New York. P-207, Elec. World.

DESIGNING, electrical and mechanical engineer thoroughly experienced in design and development of electric motors and generators; permanent with excellent opportunity. Salary $250 to $350 month to start. No advance fee. Address The Engineering Agency, Inc., 1662 Monadnock Block, Chicago, Ill.

DESIGNING engineer—Must be first class on motors, generators, etc. Write or wire us full experience. H. H. Harrison & Co., Confidential Employment Service, Chicago, Ill.

**EXECUTIVES**

seeking superior positions find our confidential service extremely satisfactory. Let our Mr. H. H. Harrison confidentially negotiate for you suitable positions with proper employers, as he has successfully done for thousands of others since 1909. Inquiries invited.

**THE NATIONAL BUSINESS BOURSE**
Confidential Negotiators
Association Building, Chicago

**Employment Service for Employers**

Investigated records and references of 25,000 engineers are available to employers of professional engineers.

The right man for the work required may be obtained **without cost** to the member of American Association of Engineers or the employer.

Employers are invited to write for our circular telling how the bureau operates and how it can serve you. It is conducted by engineers for engineers.

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• • • OPERATED BY AMERICAN ASSOCIATION OF ENGINEERS • • •
AS ONE OF ITS SERVICES TO ENGINEERS AND INDUSTRY
**61 East Adams St., Chicago**

*Employers wire nearest office for quick service:— New York, Washington, Boston, Pittsburgh, Detroit, St. Paul, St. Louis, El Paso, Los Angeles, San Francisco, Portland, Seattle, Omaha.*

## POSITIONS VACANT

DISTRICT superintendent wanted for light and power territory serving several hundred population as well as operating small gas plant, and must be experienced in meeting the public and understand line work, in order to keep his district in good order. Fullest co-operation will be given, and a good future is offered. In reply, give full particulars, when can report for work, references and salary desired. P-205, Elec. World, Real Estate Trust Bldg., Phila.

HYDRO-ELECTRIC operators wanted for a moderate sized plant located near a small village. Wages $100 per month with modern house furnished free. Applicants should state age, experience and give list of former employers to whom we may refer. St. Lawrence Transmission Company, Potsdam, N. Y.

LINEMAN, to act as trouble man. Hours 1 p.m. to 10 p.m. Steady position for capable man. Apply by letter to Village of Rockville Centre, Long Island.

LINE foreman wanted by public utility in town of 25,000 people. Distribution system 2,300 volt, three phase. Must understand thoroughly line construction and maintenance. Give detailed report of experience and salary expected. Location, Southeast. P-200, Elec. World, Real Estate Trust Bldg., Phila.

OPERATING engineer wanted for shift in 10,000 kw. steam turbine plant. P-202, Elec. World, Old Colony Bldg., Chicago.

OPERATING shift engineer wanted. Power station northeastern Texas, furnishing railway and light. Turbines and reciprocating engines, condensing and non-condensing; experience outside of power houses not considered. P-206, Elec. World, Old Colony Bldg., Chicago.

VACANCY for engineer or draftsman experienced in the design of electric locomotives for mine or industrial use. Excellent opportunity for the right man. Give all details; confidential. Address P. O. Box 85, Ironton, Ohio.

TWO FIRST-CLASS, non-union, foremen wanted for line construction work; 85c. per hour; 9 hours a day; steady employment. P-179, Elec. World, Real Estate Trust Bldg., Phila.

## EMPLOYMENT AGENCY

AMERICAN Service Company, Pittsburgh, require proposals for interested employers: Steam-electric efficiency engineer central stations, $5,000; electrical superintendent, utility, electric railway—5 miles; power manager, Eastern traction light plant; manager West Indies, utility, $4,000; steam auxiliary engineer, South; meter engineer, Michigan, $1,800; switchboard operators, Ontario, Pennsylvania, Tennessee, Idaho; sales engineer, motors; superintendent, hydro-electric system, Northwestern. International Service reaching selected employers in any territory preferred.

## EMPLOYMENT SERVICE

EXECUTIVES qualified for salaries of $2,500 to $25,000 and upwards are invited to communicate in strict confidence with the undersigned, who will conduct preliminary negotiations for such positions; the procedure used is peculiar to this service, differing essentially from all others; and is constructive and initiative; applied individually; and in no way jeopardizing present connections; established 1910; send name and address only for particulars. R. W. Bixby, Inc. 310 Lockwood Building, Buffalo, New York.

## POSITIONS WANTED

CENTRAL station operating engineer, 28 years old, ten years' experience in steam power stations, G. E. turbines, stokers and oil firing. PW-180, Elec. World.

CHIEF operator or station superintendent; seventeen years' experience in operation, maintenance and construction; ten years' with one of the largest companies in the East; North Central states preferred; salary reasonable. PW-181, Elec. World, Leader-News Bldg., Cleveland.

CHIEF electrician and master mechanic; twelve years' experience on industrial plant electrical and mechanical maintenance, armature winding, shop work, electrical welding application and general repairs to plant equipment; can manage men; best of references; age 30 years, married; at present employed but desire a change; will go anywhere. Post Office Box 81, Chester, Pa.

CHIEF electrician, 30, technical education, 12 years' experience industrial and central plants high and low tension. Location immaterial. PW-154, Elec. World, Old Colony Bldg., Chicago.

CHIEF electrican with engineering practice, 12 years, light and power, steam and oil plants, transmission line, telephone and telegraph equipment and line construction experience, American, age 30, heatlhy, married; do not use intoxicants, speak Spanish fluently, at present chief electrican large company in tropics, desire change, prefer Central or South America. Address PW-176, Elec. World, Old Colony Bldg., Chicago.

CHIEF electrician, 14 years' maintenance, construction and operation; broad experience with frequency changers, rotary converters, motor-generators, transformers and winding. Construction of remote controlled switching equipment, testing and installation of switchboard instrument; age 31, married; high school education; available at once. Elwood Greene, Box 192, Mt. Hope, W. Va.

COMMERCIAL agent or manager of electric or gas and electric property; college man, practical construction and commercial agent experience; fully qualified to assume charge of all public relations with consumers relative to complaints, rates, negotiations for main or line extensions, etc. Know sales game thoroughly; can handle men; age 42; health perfect; attendance record 100%. No bad habits; clean record; references. PW-212, Elec. World.

ELECTRIC-MECHANICAL engineer, age 31, technical graduate; two years' construction, two years public utility, one year railroad, two years teaching; married. PW-184, Elec. World, Real Estate Trust Bldg., Phila.

ELECTRICAL estimator and engineer, 14 years' experience as mechanic, foreman, estimator and engineer. Member of Chicago Electrical Estimators Association. PW-190, Elec. World, Old Colony Bldg., Chicago.

ELECTRICAL Engineer, technical graduate, eight years experience, desires permanent position as assistant, to Superintendant of Power, western location preferable. PW—149 Electrical World, Old Colony Bldg., Chicago.

ELECTRICAL, mechanical engineer, 20 years' experience in the erection, maintenance and operation of practically all classes of machinery in power plants, factories and mines; technical education, speak English and Spanish; married; salary $5,000 to $6,000 annually; available in 60 days. PW-210, Elec. World.

ELECTRICAL mechanical engineer, technical graduate, age 35, 15 years' thorough experience construction, operation and supervision of steam and electrical installations; especially trained as manager or superintendent of public utility or electrical engineer in industrial plant; at present with large chemical company as power-engineer. PW-159, Elec. World, Leader-News Bldg., Cleveland, Ohio.

ENGINEER and executive — Fourteen years' practical experience in the design, construction and operation of engineering structures and industrial plants, holding positions as general superintendent, and engineer of works. Technical graduate in mechanical engineering, 1907, desires position requiring high ability and hard work but offering opportunity for advancement. PW-171, Elec. World.

EXECUTIVE, electrical engineer, technical training; 12 years' experience with large power companies; thoroughly familiar with electric meter work, distribution and transmission construction, industrial power sales work and general executive end of public utility work; age 38; married. PW-196, Elec. World.

GRADUATE electrical engineer, eight years' engineering experience with public utility companies desires responsible executive position with operating company. PW-186, Elec. World, Old Colony Bldg., Chicago.

LINE foreman over electric light and trolley; 25 years' practical experience, 15 years of that time having full and complete charge of construction and maintenance work and all men in construction department. Prefer Middle West or Pacific Coast. Can take complete charge of above work in any property. P. O. Box 273, Bristol, Tenn.

MANAGER public uitlties or assistant to president in operating railway, gas, water or electric lighting properties; technical, long experience covering design, construction, operation and management of combination properties; fine executive and can produce results. PW-194, Elec. World.

## POSITIONS WANTED

PUBLIC utilities manager in town of 15,000 desires new and larger connection, considerable experience in operation of electric light, power, heating, ice and gas properties; good on power plant design, operation or construction, also high tension operation and construction; can handle men and produce results; splendid recommendations including present employers. PW-209, Elec. World, Old Colony Bldg., Chicago

TECHNICAL graduate desires position in distribution department; two years' experience in construction and estimating distribution lines. Location immaterial. PW-146, Elec. World, Real Estate Trust Bldg., Phila.

VALUATION engineer, graduate E.E. University of Illinois. Completing valuation work for large public utility—street railway, gas, electric, water, ice and steam heat properties. Four and one-half years' experience maintenance, construction valuation in U. S. A. and abroad. PW-213, Elec. World, Old Colony Bldg., Chicago.

WANTED—Position as working superintendent or head electrician of small municipal lighting plant or any lighting plant. Southern or Southwestern States preferred. Address Harold G. Roberts, Box 206, Attica, Wyo Co., N. Y.

## WORK WANTED

**Fifteen First-Class Linemen**

Have gang of 15 first-class linemen; available on short notice for any emergency auxiliary work. Can be used as whole or in part. References. WW-211, Elec. World.

## AGENTS AND SALESMEN

**Agencies Wanted**

I am interested in hearing from manufacturers that have something of merit to market in electrical specialties, appliances, etc. I have a big following, and am personally acquainted with the jobbing trade large and small in territory from Cleveland to Denver, and from Memphis, Tenn., to Canada. My office in Chicago. AS-144, Elec. World, Old Colony Bldg., Chicago.

**Electrical Engineer**

With successful record in selling commercial power motors through trade channels, also experience and knowledge of sales work through electric jobbing trade. A permanent and remunerative position for man who will accomplish results for well established manufacturer. Address P. O. Box 977, City Hall Station, N. Y. and state qualifications, experience and salary desired.

**Excellent Opportunity for Live Wire**

Salesman wanted to solicit motor repairs and sales—territory, Massachusetts and bordering states. Must have experience and some following. Excellent opportunity for a "live wire" with a good sized growing concern. AS-172, Elec. World.

**Lighting and Appliance Salesmen Wanted**

Central station company located in Middle West wants several experienced lighting and appliance salesmen; salary and liberal commission. AS-189, Elec. World, Old Colony Bldg., Chicago.

**Sales Representatives Wanted**

Able and active sales representatives wanted throughout the States to handle a line of pneumatic pressure systems, deep well, condensation and centrifugal pumping machinery. Company established many years has complete manufacturing plant and many thousands of pumps in operation. An excellent opportunity for a number of capable representatives. AS-197, Elec. World.

**Salesman Wanted**

Nationally known manufacturer of oil storage equipment for steam and electric railroads has valuable territory open for experienced railroad specialty salesman. Personal acquaintance among operating and purchasing railroad officials advantageous. State references and experience. P. O. Box 1173, Milwaukee, Wis.

## BUSINESS OPPORTUNITIES

**Capital Available for Electrical Business**

Young man wishes to invest two thousand dollars with an electric service company or service and supply store in a small city; experienced in operation and construction; good technical education. BO-185, Elec. World, Leader-News Bldg., Cleveland.

**Declining Electrical Business**

Offer for sale, electric decorative cable. One man with screw driver can install; 1,000 lamps per day. Big returns on rental basis. American Tool & Machine Co., 1212 Wilson Bldg., New York City.

**Partner Wanted**

Owner retiring desires partner with $5,000 cash and services. High-grade electric repair shop, fully equipped, complete stock; central New York City; established 1901; doing good business. BO-208, Elec. World.

## SALESMEN AVAILABLE

EASTERN Territory wanted. Sales engineer representing large concern on industrial plant equipment in New England and Eastern States desires additional lines. AS-203, Elec. World, Old Colony Bldg., Chicago.

FOREIGN—sales engineer, electrical, mechanical, American; 10 years' sales experience South America, West Indies, Mexico and Orient; speaks Spanish, Portugese, German fluently, executive ability, recently returned from Mexico, desires to represent American firm. Unquestionable references. Arthur Walser, Box 457, Lidgerwood, North Dakota.

LIVE sales organization wants more lines. Lines must possess exceptional merit and carry ample margin to warrant intensive sales effort. Old established firm covering western Pennsylvania, eastern and northern Ohio and West Virginia; offices in Pittsburgh and Cleveland. AS-201, Elec. World, Real Estate Trust Bldg., Phila.

MANUFACTURER'S agent or sales manager. Are you interested in New York representation? Am looking to represent in New York City and radius of 75 miles, manufacturer of well-known electrical specialties. Preferably independent manufacturer. Will consider incandescent lamp as side line. Thoroughly familiar with jobbing, contracting and supply trade. Fullest investigation given and expected. Peter J. Farron, Room 76, 37 Maiden Lane, New York City.

WANTED to represent in North Carolina manufacturer or jobber of electrical supplies and appliances. Have 10 years' experience; clean habits; best of references. Can produce results. Box 421, Burlington, N. C.

## FOR SALE

**DeLaval Centrifugal Oil Clarifier**

New; never used. Make offer. Address, Box 217, Deland, Ill.

**Range For Sale**

Hughes No. 30 Range, plain finish, 220-volts. Complete with warming shelf, $60 f.o.b. North Judson Electric Company, North Judson, Ind.

## EDUCATIONAL

**Bliss Electrical School**

Condensed course in electrical engineering complete in one year for men of character, ambition and limited time. Diploma in one year. Theoretical principles and practical applications of electricity. Mathematics, steam and gas engines, mechanical drawing, extensive shop work, construction, installation, testing. Fireproof dormitories, dining hall, laboratories, shops. Twenty-ninth years opens Sept. 28th, 1921. Write for catalog. 128 Takoma Ave., Washington, D. C.

## MISCELLANEOUS

**Publicity**

Special publicity for protection of properties against political attacks of all kinds; 15 years' experience, rates, franchises, etc. Commercial and financial advertising and campaigns. Consultations. M-743, Elec. World, Old Colony Bldg., Chicago.

**Municipal Ownership**

If threatened with municipal ownership or other competition, secure expert advice. Dozens of successful campaigns. M-742, Elec. World, Old Colony Bldg., Chicago.

## OFFICIAL PROPOSALS

INVITATION FOR BIDS FOR

### Complete Electrical Installation

ON RONDOUT SUSPENSION BRIDGE
Kingston, N. Y.

Plans and specifications to be seen at the office of the Terry & Tench Co., Inc., Grand Central Terminal, New York City.

### Morwell Project Boiler Equipment

TENDER DATE EXTENDED

The State Electricity Commissioners of Victoria, Australia, have extended the date for receiving, at their office in Melbourne, tenders on Specification No. 99, water tube boilers and accessories, to noon on Aug. 31, 1921.

## U. S. GOVERNMENT

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 10 1921.—Sealed proposals will be opened in this office at 3 p.m., July 8, 1921, for Furniture, Lighting, etc., in the United States Post Office and Custom House, at Nashville, Tenn., in accordance with specification and drawing, copies of which may be had at this office or at the office of the Custodian, Nashville, Tenn., in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 9, 1921.—Sealed proposals will be opened in this office at 3 p.m., July 7, 1921, for Conduit and Wiring Changes, Lighting Fixtures, etc., in the United States Post Office and Custom House, at Cairo, Ill., in accordance with specification and drawings, copies of which may be had at this office or at the office of the Custodian, Cairo, Ill., in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 9, 1921.—Sealed proposals will be opened in this office at 3 p.m., June 30, 1921, for supplying to the various public buildings under the control of the Treasury Department hand, electric, portable vacuum cleaners during the fiscal year ending June 30, 1922, in accordance with the specifications, copies of which may be had at this office in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 16, 1921.—Sealed proposals will be opened in this office at 3 p.m., July 8, 1921, for the installation complete of an electric dumb waiter in the United States Post Office at Lima, Ohio, in accordance with the drawings and specification, copies of which may be had at this office in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 17, 1921.—Sealed proposals will be opened in this office at 3 p.m., July 11, 1921, for the installation complete of an electric passenger elevator in the Infirmary, U. S. Public Health Service Sanatorium, at Dawson Springs, Ky., in accordance with the drawing and specification, copies of which may be had at this office in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

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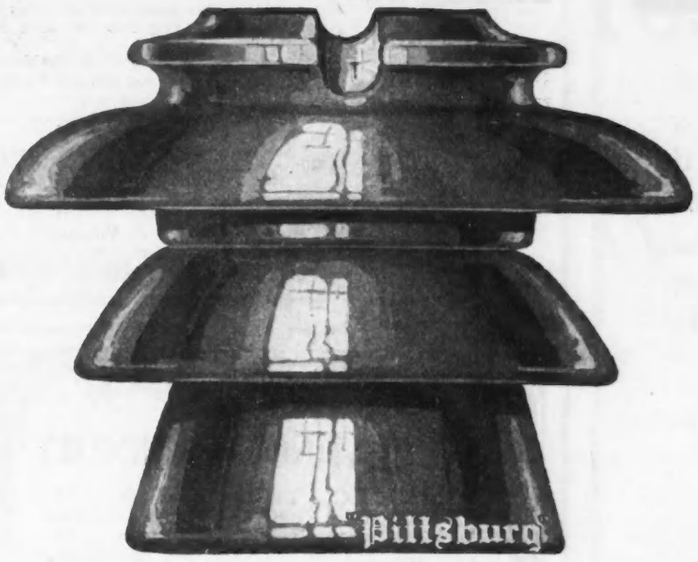


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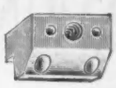

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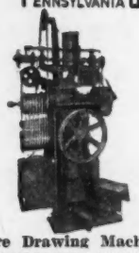

Wire Drawing Machine

1

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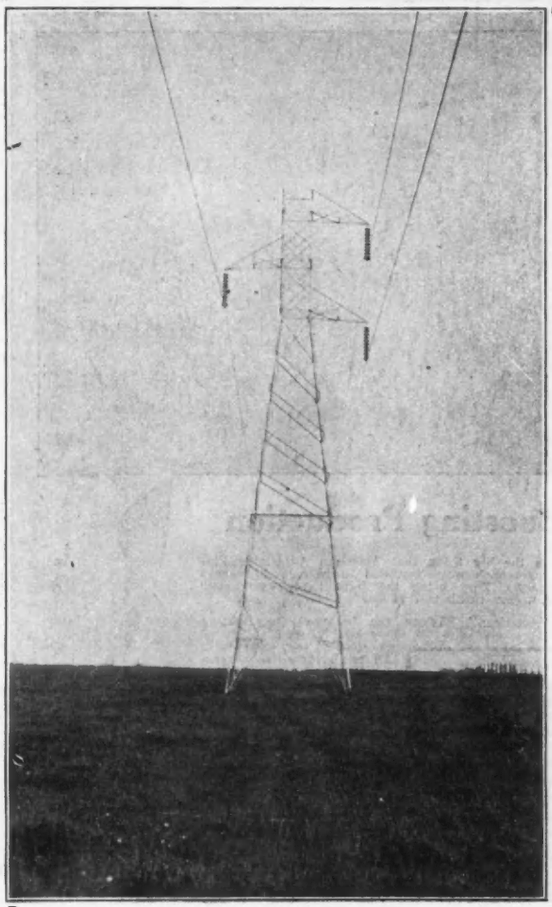
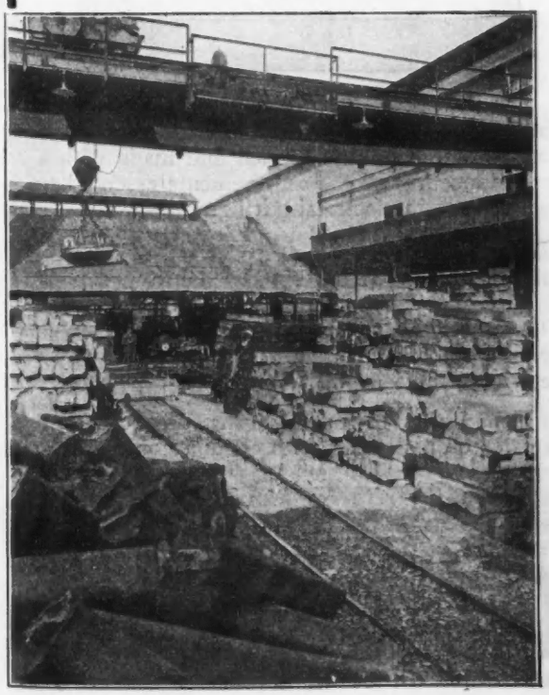


Upper—Valley type tower of Great Western Power Company 165,000-volt Caribou-Valona transmission line.

Lower—Stacks of steel ingots cast from Open Hearth Steel at mill of Pacific Coast Steel Company.

Lower right—3000 tons of steel tower members for Western Transmission Lines, ready for shipment from the Pacific Coast Steel Company yard.



# 165,000 Volts a Reality

WITH current turned into the 190-mile Caribou-Valona transmission line of the Great Western Power Company, carrying 60,000 kw. at 165,000 volts, Western progress passes another milestone. Subjected to every unfavorable condition that influences transmission line practice—snow, sleet, wind, fog, electrical storms, heat and cold, waterways and long spans—this line stands as a tribute to Western engineering.

The various influencing factors in this line's design and construction resulted in a need for several types of Transmission Towers — 1430 towers in all, of nine distinct styles. Each style of tower was required to not only meet the usual demands of standard practice, but to take care of special conditions which were peculiar to the individual locations.

That the **Pacific Coast Steel Company** was selected to supply all of the towers is the most conclusive evidence of the ability this organization has shown, during its years of activity, in building Transmission Towers.

## Pacific Coast Steel Company

*Manufacturers of structural shapes, merchant and reinforced bars*

**General Offices: Rialto Building, San Francisco**
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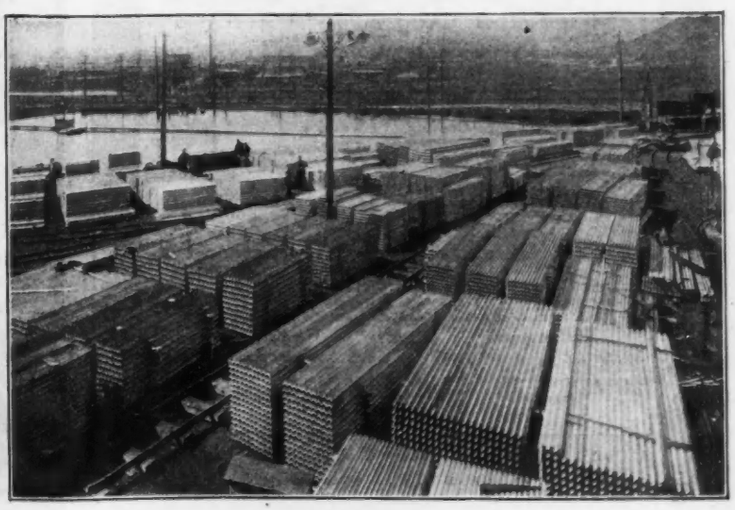

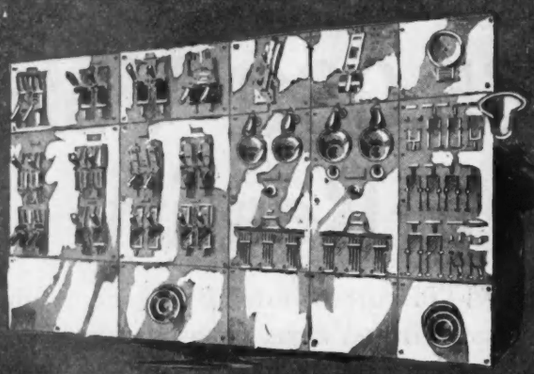

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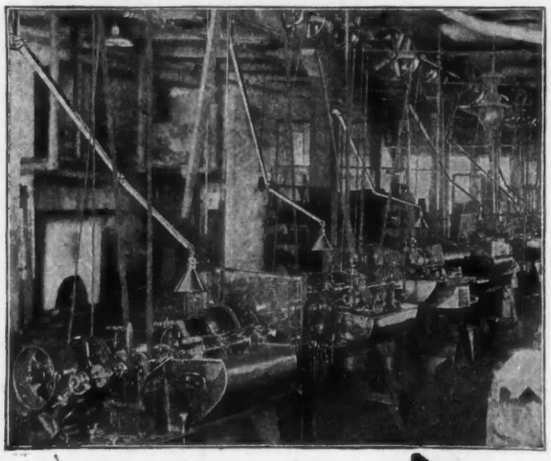

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Made from easy bending Spellerized Mild Steel Tube. Protected from rust by a heavy deposit of pure, non-corrosive zinc. Enameled inside with especially prepared black enamel which forms a smooth, glossy interior, through which the wires are easily fished.

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Of course, it is made of Open Hearth Steel and is Hot Galvanized, every part of it, the Hubbard way.

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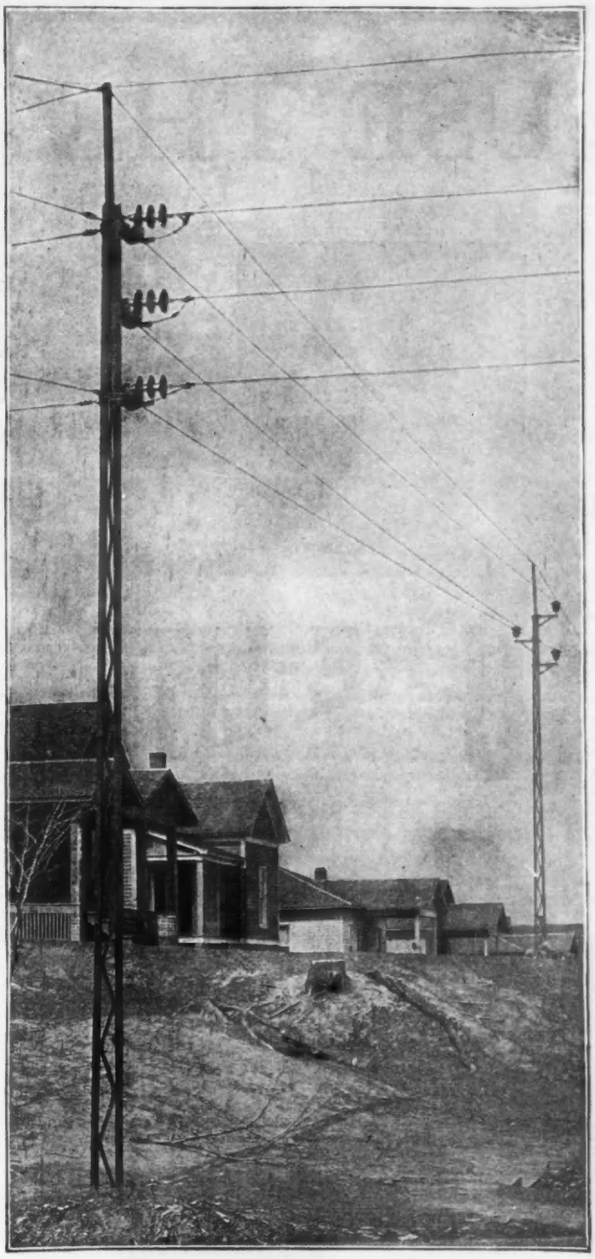

# Bates Pole Prices Reduced

Reflecting the spirit of the times and realizing the necessity of returning to normal conditions as rapidly as possible, the prices of Bates One-Piece Steel Poles have been reduced. The new prices will be effective April 1st, 1921, and will apply on all quotations and proposals now outstanding.

It is our desire to boost the expansion of the Central Stations and Electric Railways in the most substantial manner possible by this reduction. It is our hope that this action will encourage and revive plans for lines that are now dormant.

Readjustment must come. The time is here and now — even though it means a sacrifice—and we are glad to assure the pole users of the world that we expect to do our share.

Write for our new price schedule and our 1921 Steel Pole Treatise and plan for permanent construction with Bates One-Piece Steel Poles.

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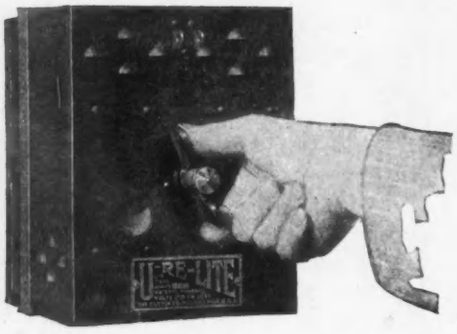


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and you will cut your fuse maintenance to nothing!

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Buy U-RE-LITES and they will be serviceable not "until used" but "forever after," thereby being chargeable to capital account.

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**It excels in**
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suitable for every service requirement.

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Kester Wire Solder
Self-Fluxing
Kester Rosin-Core Wire Solder—for delicate electrical work. Flux is contained in hollow wire of solder. Saves time, labor, material. Write for free sample.
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Primary Cutouts

stand up under the most rigid service conditions, giving real satisfaction.

Strength of structure is provided for in the heavy porcelain. Designed to be weather-proof when installed on the cross-arms and each conductor is held in position in the terminals by two screws to prevent loose connections. All live parts are amply recessed and protected to prevent injury from contact.

Positive protection to your branch circuits, transformers and arc lamp circuits is given—in case of trouble the circuit is instantaneously opened, especially where the disruptive effect is severe, due to high capacity.

A dependable factor of safety has been employed in the use of contact surfaces and insulation.

List No. 10350
Primary Cutout
0 to 100 Amperes

Metropolitan Device Corporation
1250 Atlantic Avenue, Brooklyn, N. Y.

METROPOLITAN DEVICE CORPORATION,
1250 Atlantic Ave., Brooklyn, N. Y.

Gentlemen: Please send on 30 days' approval for trial two list No. 10350 Primary Pole Cutouts 2600 volts, with ..... ampere fuses for same. If satisfactory I will send you order covering material sent.

Name of Company .....
By ..... Title .....
Address .....
.....
Date .....

# SHERMAN
## GROUND CLAMP

APPROVED

## WHY?

1. All copper in one piece securing high conductivity and a tight grip.
2. Furnished with *approved* soldering lugs.
3. Equally good for soldered or solderless connections.
4. Adjustable—three sizes covering all requirements.
5. Easiest and quickest to apply.
6. A screw-driver only necessary.

*"None are as good—few are as cheap"*

**H. B. SHERMAN MFG. CO.**
**Battle Creek, Michigan**

*Note Protection at Corners*

## Blake Insulated Staples

Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for Samples.

**Blake Signal & Mfg. Co.**
**Boston, Mass.**

ESTABLISHED 1909

**Monarch Refillable Fuse Co.**
**JAMESTOWN, N. Y.**

# Shelton
## Vibrators

Write for Catalog of Shelton Specialties

Shelton Electric Co.
New York Chicago
Boston San Francisco

## Carbo Steel Poles
## *Best by Test*

Carbo design permits of economical use of material, greater strength—not confined to any special size. Can meet any requirements. *No concrete* should be used to anchor—there's a big saving which also adds to their strength and economy. Prompt attention given all business.

*Painted or hot galvanized.*

**CARBO**
**Steel Products Co.**
2600 W. 111th St.
Morgan Park P. O.
Chicago, Ill.

## Alloys for Electrical RESISTANCE

**DRIVER-HARRIS COMPANY**
HARRISON, NEW JERSEY
Chicago - Detroit - Canada - England - France

AIR BREAK SWITCHES

OFFICE AND FACTORY 3205 CROTON AVENUE

**HI-VOLTAGE** Equipment Company
Cleveland

## I-C
### Controlling Devices

Automatic and hand operated Starters and Controllers for all conditions of service.

**Industrial Controller Co.**
MILWAUKEE

## Aladdin's Lamp
*has nothing on the*
## "Searchlight"

When an advertiser sells equipment for over $4,000.00 through "Searchlight" advertising that cost $12.00, we think "Searchlight" is at least entitled to "favorable mention."

615

**Searchlight Section**
**Employment — Equipment — Business Opportunities**

**Kantshok** Safety Entrance

It takes but 15 minutes to install the Kantshok—the safest, simplest and most efficient entrance ever devised. Send for details.

The Lewis Electric Co., Canton, Ohio

THE ELECTRIC MOTOR CO. CANTON, O.

**SWITCHBOARDS**
for
Industrial and Commercial Uses
THE ELECTRIC MOTOR & ENGINEERING CO.
CANTON, OHIO

ELECTRICAL ENGINEERS EQUIPMENT CO. THREE E CHICAGO, U.S.A.

Power Station and Distribution Specialties
Use "Three-E" Products for their built in *quality* and *superior design*. We are specialists in High Tension Equipment
Electrical Engineers Equipment Co
711 Meridian St., Chicago, Ill.
21 Park Row, New York City
*Sales offices in all the principal cities*

**STANDARD**
WIRES, CABLES AND CABLE ACCESSORIES
*Manufactured by*
STANDARD UNDERGROUND CABLE CO.
*Branch offices in all principal cities.*

ELECTRIC POWER EQUIPMENT CORPORATION ELPEco PHILADELPHIA, PA.

*Mfrs of*
*Control Switches,*
*Switchboard Fittings,*
*Disconnecting Switches,*
*Bus Supports, Choke Coils*
*Bulletin on Request*
13th. and Wood Sts Philadelphia, Pa

**Mason Safety Switches**
are
100% Safe to Use
100% Safe to Fuse
The Trumbull Vanderpoel Electric Manufacturing Co.
Factory: Bantam, Conn.

**THE FOUNDATION COMPANY**
*Engineering Construction*
NEW YORK AND OTHER LEADING CITIES
HYDRO-ELECTRIC AND STEAM POWER DEVELOPMENTS

**SUNDH** SPECIAL PANELS FOR REMOTE **CONTROL**
SUNDH ELECTRIC CO.
Ave. C and Parkhurst Ave.
Newark, N. J.

Your advertisement in a space this size in all issues where larger display space is not used backs up your main efforts and places your name in the alphabetical index.

Electrical World
*The National Exponent of Electric Service*

# DUNCAN A. C. WATTHOUR METER

**MODEL M2**

**DUNCAN ELECTRIC MFG. CO., Lafayette, Ind.**

For testing insulation resistance of generators, motors, transformers, switchboards, insulators, cables, etc., there is only *one best way*, and that is to use our approved

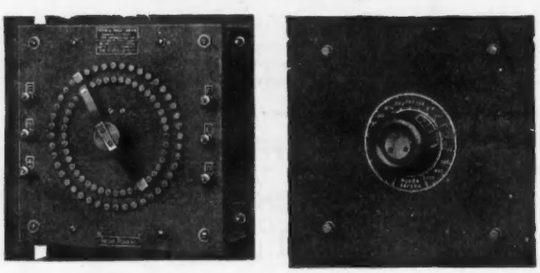
## MEGGER-METHOD

The first cost of a Megger Testing Set or Bridge-Megger is small by comparison with the saving in time and upkeep which results *invariably* from intelligent use of one of these valuable instruments. They are apt to *"pay for themselves"* very soon!

**The subject warrants careful investigation.**
**Let us send you a copy of Catalog 941.**

**James G. Biddle**
**1211-13 Arch St., Philadelphia**

# STATES POTENTIAL PHASE SHIFTERS



make it a simple matter to test any Watt-Hour meter at any power factor. No skill whatever is required—just turn the pointer to the position which indicates the desired power factor.

**THE STATES CO.,** 19 New Park Avenue, HARTFORD, CONN.

3

# Did You Know

that you can **now** get Alternating Current

**Ammeters**
**Voltmeters**
**Single Phase Wattmeters**
**Polyphase Wattmeters**
**Frequency Meters**
**Power Factor Meters**
**ALL IN 9 INCH CASES?**

*Well, you can.*

The Roller-Smith Type "NA" line of instruments is ready.

***Send for Bulletins D-450 and D-470.***

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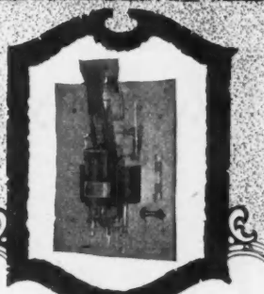
BIRMINGHAM, Brown-Marx Bldg.
BOSTON, 141 Milk St.
BUFFALO, Ellicott Square
DALLAS, 2002½ Live Oak St.
DENVER, U. S. Nat'l Bank Bldg.
LOS ANGELES, Title Insurance Bldg.
MEMPHIS, 493 S. Main St.
MINNEAPOLIS, 414 South 6th St.

**ROLLER-SMITH COMPANY**
**Electrical Instruments, Meters and Circuit Breakers**
**237 Broadway NEW YORK**
**WORKS: Bethlehem, Pa.**

MONTREAL, Power Bldg.
PHILADELPHIA, Drexel Bldg.
PITTSBURGH, Union Arcade Bldg.
SALT LAKE CITY, 59 W. Broadway
ST. LOUIS, Railway Exchange Bldg.
ST. PAUL, Pioneer Bldg.
SAN FRANCISCO, 589 Howard St.
SEATTLE, 524 First Ave., So.
TORONTO, 183 George St.

**CHICAGO, Monadnock Block** **CLEVELAND, 7016 Euclid Ave.** **DETROIT, Majestic Bldg.**

# The Circuit Breaker with Brains



*The*
*Automatic Reclosing Circuit Breaker*
**KNOWS** When to Open and also When to Reclose
AND DOES IT
AUTOMATICALLY

The Automatic Reclosing Circuit Breaker Company
Columbus Ohio

*For the sake of Complete Protection to your equipment and service*
***"Let's Get Acquainted"***

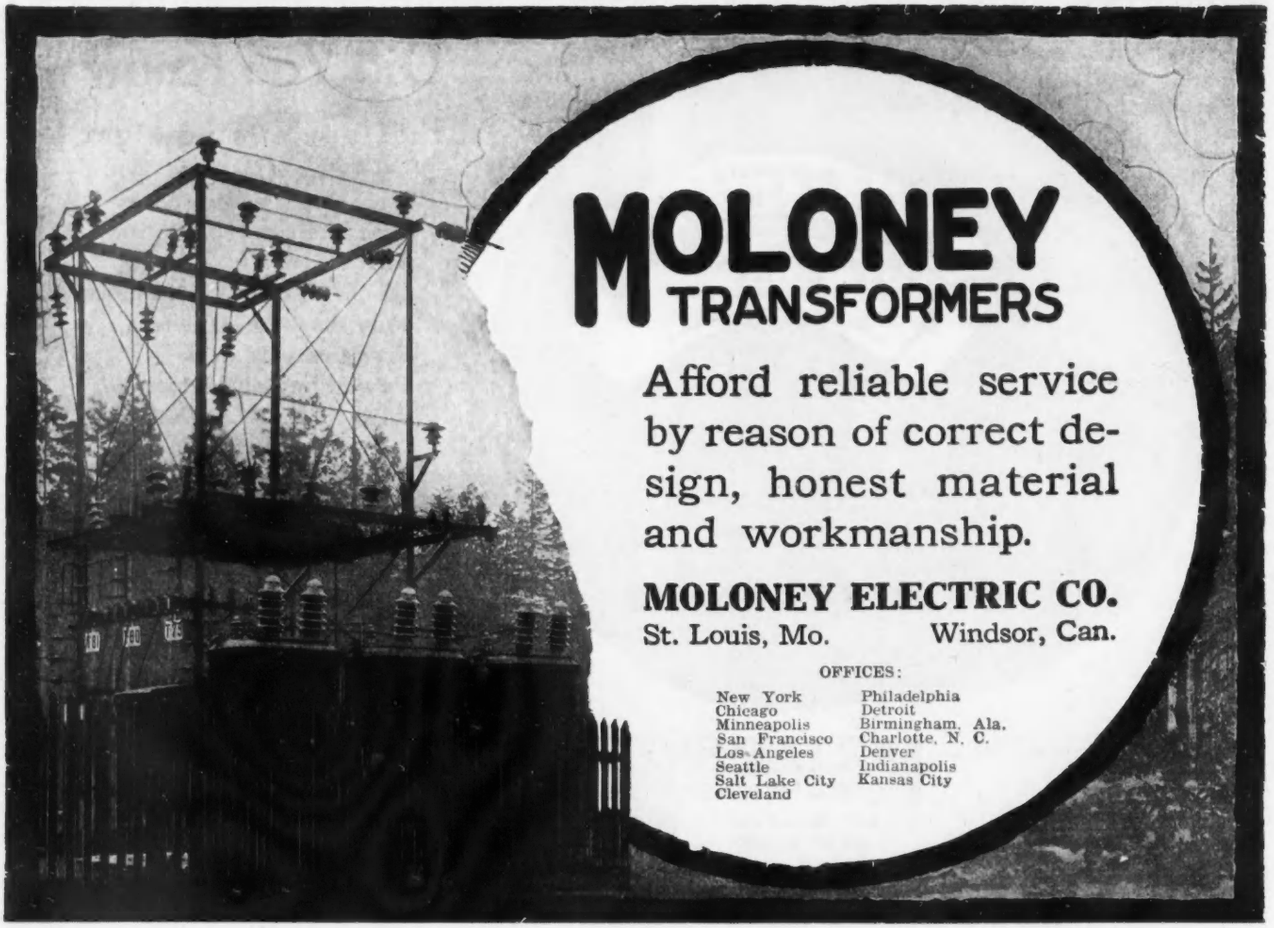
JEWELL JEWELL

## "Instruments of Character"

For A.C. and D.C. power boards our pattern No. 31 instrument, 7 in. face and scale 5 in. long, is fast becoming recognized as a standard. We also manufacture this same style instrument in 5 in., 6 in. and 9 in. sizes. Send for Catalog No. 12.

*Offices in Principal Cities*

**Jewell Electrical Instrument Co.**
**Chicago**



# MOLONEY TRANSFORMERS

Afford reliable service by reason of correct design, honest material and workmanship.

**MOLONEY ELECTRIC CO.**
St. Louis, Mo. Windsor, Can.

OFFICES:

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| New York | Philadelphia |
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| San Francisco | Charlotte, N. C. |
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| Cleveland | |

# Pittsburgh Transformer Company

Largest Manufacturers of Transformers exclusively in the United States

Pittsburgh, Pennsylvania

# Paragon Grounds

*cones cylinders*

Made of pure continuous copper from base to point of connection with leading-in wire above surface of the earth. The best material for grounds, used in the most effective way. Not subject to corrosion or deterioration in any way.

Absolutely dependable, indestructible, and of ample capacity to afford the best protection.

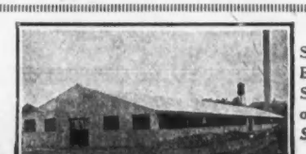
*Write for full information and a copy of our latest book on grounding, "Grounding Facts."*

*Paragon Electric Co.*

Dearborn & Van Buren Sts.
Chicago

AMERICAN TRANSFORMERS
CUSTOM MADE
SUPERIOR DESIGN AND QUALITY, FOR EVERY USE
AMERICAN TRANSFORMER COMPANY
NEWARK, N. J.

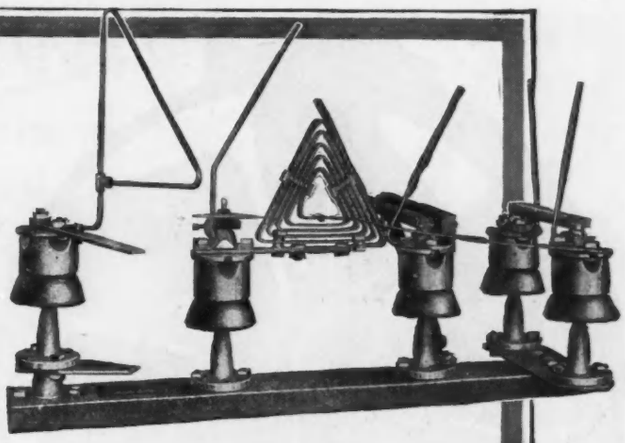
Complete
Steel Frame
Permanent
Fireproof
Weatherproof



Suitable for
Electrical
Service
of all kinds.
*Send for Catalog*

Milliken Brothers Mfg. Co., Inc., 2007 Woolworth Bldg., N. Y.
*Transmission Towers—Radio Towers—Steel Poles.*

# R&IE FARM-LINE EQUIPMENT



A compact and complete Single Pole Equipment, consisting of a Horn Gap Switch, Triangular Choke Coil, Lightning Arrester, Limiting Resistance and Horn Gap Fuse, so combined as to form a single unit on one base.

A minimum gaining and drilling of pole is required and the arrangement throughout is such that the complete equipment can be installed with a small amount of field work.

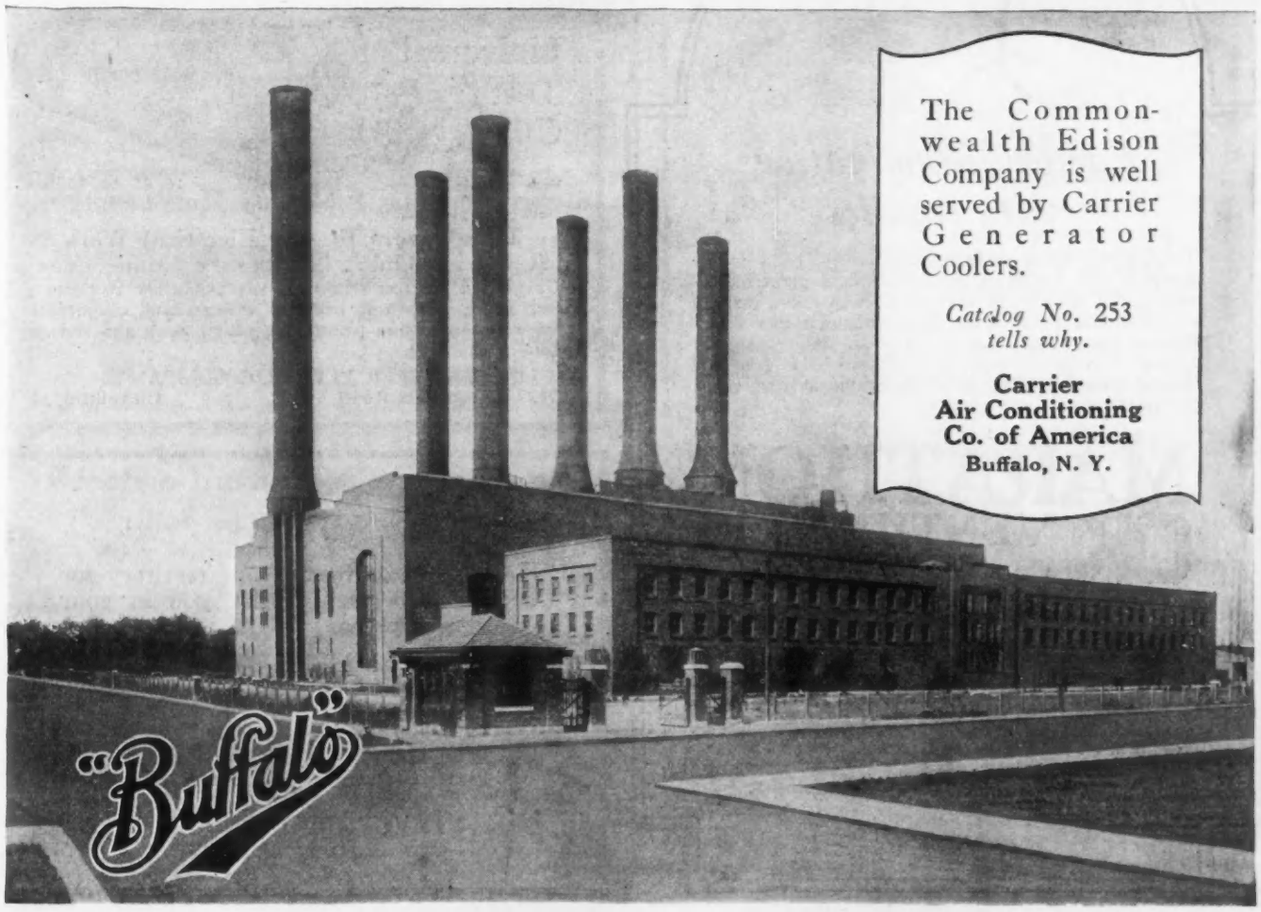
All voltages up to and including 14,000 volts.

*May we send complete information?*

RAILWAY AND INDUSTRIAL ENGINEERING COMPANY
GREENSBURG, PA.
DISTRICT OFFICES:
PITTSBURGH, CHICAGO,
NEW YORK, 2 RECTOR ST.

TRANSMISSION SWITCHING AND PROTECTIVE EQUIPMENT

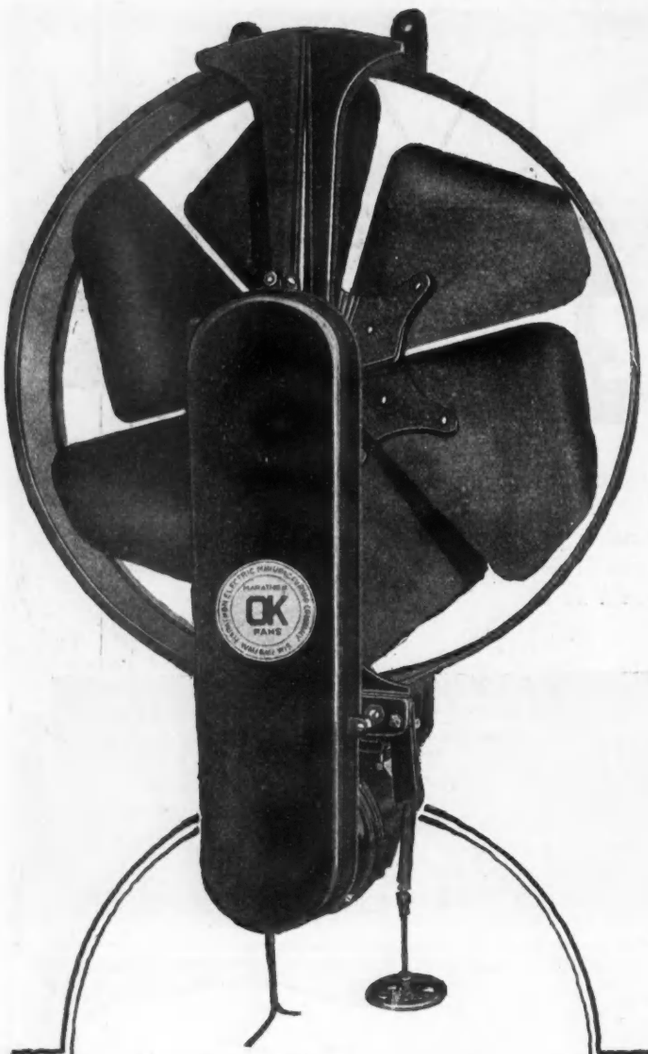
RAILWAY AND INDUSTRIAL ENGINEERING CO.




The Commonwealth Edison Company is well served by Carrier Generator Coolers.

*Catalog No. 253 tells why.*

**Carrier Air Conditioning Co. of America**
**Buffalo, N. Y.**




*Factory illumination with candles*

To expect to find contented employees, good workmanship and maximum production in a plant illuminated with candles, is not more inconsistent than to expect similar results in a plant without proper ventilation. Pure, fresh air is of vital importance in present day factory operation. It can be had in unlimited quantities and at an insignificant cost when you install a

**MARATHON OK VENTILATING FAN**

The Marathon O K Ventilating Fan is in a class by itself. It displaces a greater volume of air than other fans of equal size. It consumes less current. It is easily and quickly installed without special wiring. And yet, in spite of these features, it sells at a price far below other fans of similar performance. Isn't it worth investigating? Write today for complete data which will be sent without cost or obligation to you.

**Jobbers and dealers:** We have an interesting money-making proposition for you. Write for it without obligation.

**Marathon Electric Mfg. Co.**
712 Postal Telegraph Bldg.
CHICAGO

*Tycos*
*Tycos*
*Tycos*

There's a *Tycos* or *Taylor* Temperature Instrument for Every Purpose

*Tycos*
**Tycos**
TEMPERATURE INSTRUMENTS
INDICATING • RECORDING • CONTROLLING

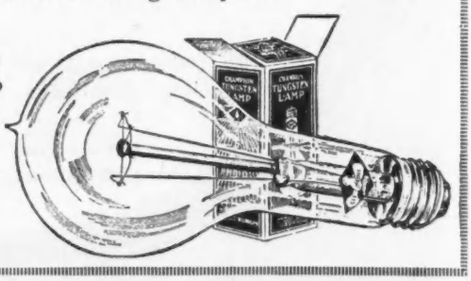
*Taylor Instrument Companies*
Rochester, N. Y.

**Mr. Jobber**

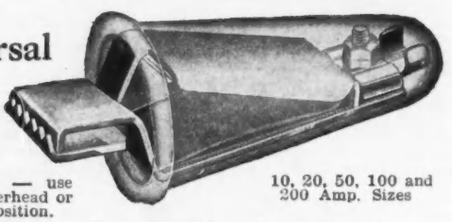
You get Real Sales Co-operation.
One of the few dependable Sources of Supply.
Unrestricted resale allowing fine profit.

**Consolidated ElectricLamp Company**
1128 Maple St.
DanVers, Mass.

*Licensed under the General Electric Company's incandescent Lamp patents.*



**Universal Test Clips**



Free sample — use company letterhead or state your position.

10, 20, 50, 100 and 200 Amp. Sizes

**Time Savers In Any Electrical Work Requiring Quick Temporary Connections**

Unexcelled for test sets, meters, transformer and motor test floors, shop test benches, college and commercial laboratories, motion picture projection work and storage battery charging.

MUELLER ELECTRIC COMPANY
2129 Fairmount Road Cleveland, O.

**Call or Write**

our representative in your territory for data or service to assist you in your advertising plans.

NEW YORK
10th Ave. at 36th St.

PHILADELPHIA
Real Estate Trust Bldg.

CHICAGO
Old Colony Bldg.

CLEVELAND
Leader News Bldg.

ST. LOUIS
Star Bldg.

SAN FRANCISCO
Rialto Bldg.

**ELECTRICAL WORLD**
Member A B C and A B P.

OSTRANDER

## Manufactures

Key Socket

**ANNUNCIATORS**
House, Hotel, Hospital, Elevator, Marine.
*Wood or metal. All styles of drops and resets.*

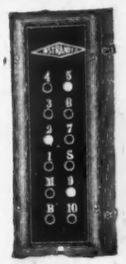
**BELLS**
Iron Box, Wood Box, Fire-Alarm, Skeleton, Vibrating, Single Stroke, Weatherproof, Electro-Mechanical.

**BUZZERS**
Iron Box, Wood Box.

Pull Socket

**PUSHES**
Wood, Metal, Desk, Door, Pear, Floor, Marine, Multiple, Table Clamp.
*All finishes.*

**SOCKETS**
Key, Keyless, Pull Chain.
*All finishes.*



Target Drop Elevator Annunciator

Iron Box Bell

**FIRE ALARMS**
Cabinets, Boxes, Systems for Current or Storage Battery.

**SHADES**
Metal Shades of All Descriptions.

**LETTER BOXES**
of All Descriptions.

**FLOOR BOXES**

**SPEAKING TUBES**
Tin Tube, Flexible Tube, Whistles, Elbows, Collars, Roses.

**BURGLAR ALARMS**
Door Springs, Window Springs, Transom Springs.

**TANK ALARMS**

Skeleton Bell

Electro-Mechanical Gong

**W. R. Ostrander & Co., 371 Broadway, New York**

Brooklyn Philadelphia Chicago Baltimore San Francisco St. Louis Detroit

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Moore Rapid Sectional Furnaces
Built in Eight Standard Sizes from 1/8 to 12 Tons. Remarkable Overload Capacity.
Pittsburgh Electric Furnace Corporation
Pittsburgh, Pa., U.S.A.

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ELECTRIC CRANES
HAND CRANES
ELECTRIC HOISTS
I-BEAM TROLLEYS
SEND FOR BULLETINS.
**MARIS BROS., Philadelphia**

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**Electric Furnace Construction Co.**
*Builders and Designers of Electric Heating and Melting Furnaces for all Purposes.*
**908 Chestnut St., Philadelphia**

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**Aladdin's Lamp**
*has nothing on the*
**"Searchlight"**

When an advertiser sells equipment for over $4,000.00 through "Searchlight" advertising that cost $12.00, we think "Searchlight" is at least entitled to "favorable mention."
615
Searchlight Section
Employment — Equipment — Business Opportunities

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CENTURIES OF SERVICE
PYRAMID NATURAL SLATE ELECTRICAL
Proof against Time - Wear - Water - Fire!

*Pyramid Brand*

This warranty is an assurance of gratifying success in the selection of

**Pennsylvania Slate**

for switchboard installations. The economical and sturdy qualities of slate lend themselves most advantageously to electrical switchboard development. Climatic and atmospheric conditions cannot damage this product of nature.

Large stocks of carefully selected slabs are ready for immediate shipment to all parts of the world.

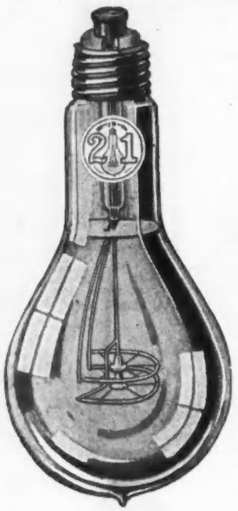
**The Structural Slate Co.**
**Pen Argyl, Pennsylvania**

# NEW ADDITION TO THE DUALITE FAMILY

DUA LITE

**In 75, 100 and 200 watts**

From the day the DUALITE lamp was first placed on the market, in October last, the DUALITE idea took strong root in the minds of lamp users. Since then the DUALITE idea has been expanding and circulating wider and wider.




NITROGEN WHITELITE LAMPS

**From 40 to 1000 watts**

From everywhere requests have been pouring in upon us for a DUALITE of smaller unit, till in the end we have yielded to the pressure and brought out the 75-watt DUALITE. So then for the present the DUALITE is to be had in the following three sizes:

| Watts | Volts | Price |
|---|---|---|
| 75 | 110-125 | $1.20 |
| 100 | 110-125 | $1.50 |
| 200 | 110-125 | $3.00 |

*The DUALITE is fully protected by U. S. Patents and is made and controlled exclusively by*

**WHITELITE ELECTRIC CO., 368 Broome St., New York City**

# Monson Slate

**For High Grade Electrical Equipment**

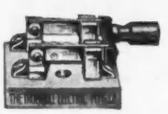
For Switchboards, circuit breakers, compensators and similar electrical equipment Monson Slate is recognized as the best.

We have just completed additions to our producing facilities which provide for double our former capacity. Thus manufacturers of electrical apparatus are assured prompt attention and quick shipments.

*Write us your needs NOW*

**Portland-Monson Slate Company**

Portland, Me. *Quarries* at Monson, Me.



Porcelain

Composition Base

## "Circle T" Battery Switches

On porcelain, fibre or Slate bases for front or back connections. The line is complete. Send for details.

**THE TRUMBULL ELECTRIC MFG. CO.**

PLAINVILLE, CONN.

New York Chicago Boston Philadelphia San Francisco

# LECARBONE

## CARBON BRUSHES

*They are uniform in quality*
*They talk for themselves*

**W. J. Jeandron**

229 Fulton Street

New York City

Pittsburgh Office: 634 Wabash Building

*Canadian Distributors:* Lyman Tube & Supply Co., Ltd. Montreal and Toronto

This Company maintains a Special Department devoted to production of

# Sheets

## For Electrical Apparatus

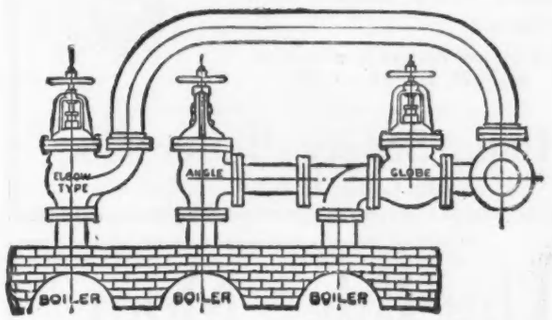
APOLLO SPECIAL ELECTRICAL—High silicon alloy for high efficiency transformers; very low core losses; non-aging. Other well-known grades are Extra Apollo Special Electrical, Dynamo Special Electrical, U. S. Electrical, American Armature, Pole Steel and Rotor Steel. Write us for information.

We also manufacture Sheet and Tin Mill Products of every description, including Black Sheets, Galvanized Sheets, Corrugated and Formed Sheets, Terne Plates, Etc.

AMERICAN SHEET & TIN PLATE CO. APOLLO SPECIAL ELECTRICAL TRADE MARK REGISTERED PITTSBURGH

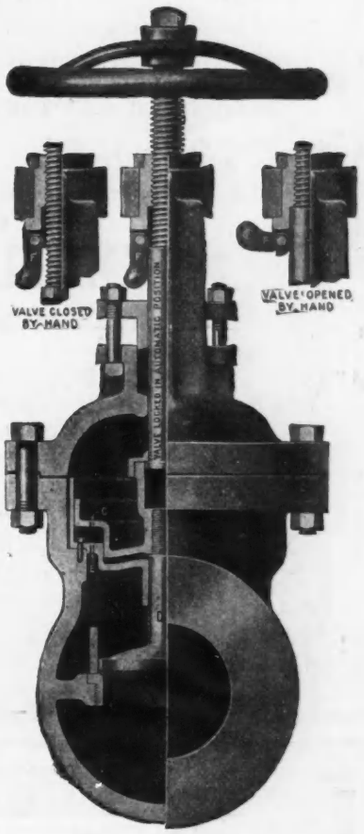
**AMERICAN SHEET AND TIN PLATE COMPANY, Frick Building, Pittsburgh, Pa.**

# Make Your Plant
## *Perfectly Safe!*




DON'T place your own life, as well as the lives of your men, and your plant in jeopardy!

*Safeguard* your entire plant against disaster following the bursting of a boiler tube, or the breaking of any steam main. *Check* the destructive outpour of steam instantly with




# GOLDEN-ANDERSON
## Life and Property Insurance Valves

These Double Cushioned Automatic Combination Triple Acting and Non-Return Valves are the only valves that can be tested from the boiler room floor without interrupting the operation of the plant. They will:

1. Cut off a boiler instantly when one of the tubes bursts.
2. Prevent live steam from entering a cold boiler, insuring safety of workmen.
3. Instantly shut off the steam from all boilers when a pipe breaks.
4. Can be opened or closed by hand in the same manner as ordinary gate or globe valves, when fitted with the patented safety latch.
5. Double cushioning prevents absolutely all pounding or chattering.

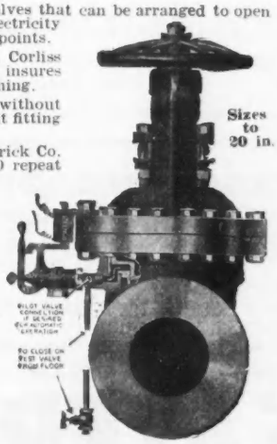
## 1997 Used by U. S. Steel Corporation

***"Safety First" is their motto.***
***It should be yours.***

**"Hosts of References"**

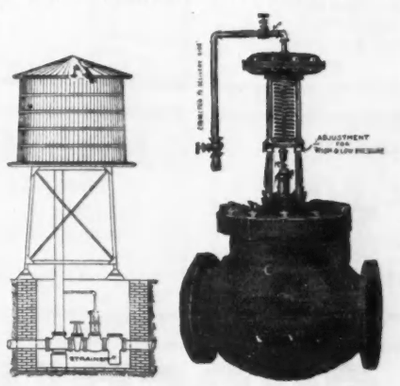
### Golden-Anderson
**Patent Double Cushioned, Quick Closing Emergency Trip Valves**

1. They can be tripped instantly from distant points by electricity on either open or closed circuits.
2. The only valves that can be arranged to open and reset by electricity from distant points.
3. Fitted with Corliss dash pot that insures perfect cushioning.
4. Operate without springs or tight fitting parts.
5. The H. C. Frick Co. have given 150 repeat orders.




### Golden-Anderson
**Patent Automatic Cushioned Controlling Altitude Valves**

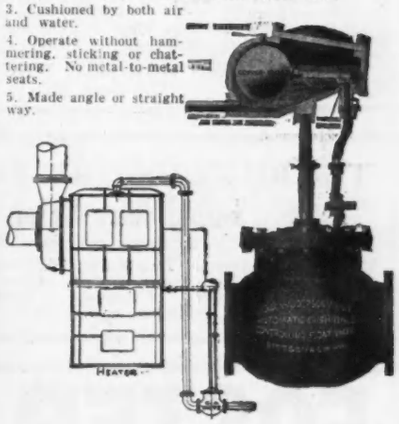
1. The valve will automatically hold a constant water level in tanks, reservoirs and stand pipes.
2. No floats or fixtures required.
3. Can be closed in three ways—automatically by water, by hand, and by electricity from distant points.




Sizes to 24 in.

### Golden-Anderson
**Patent Automatic Cushioned Controlling Float Valves**

1. They carry a constant water level in feed water heaters by perfectly controlling the flow of make-up water.
2. Operated by protected enclosed copper float.
3. Cushioned by both air and water.
4. Operate without hammering, sticking or chattering. No metal-to-metal seats.
5. Made angle or straight way.

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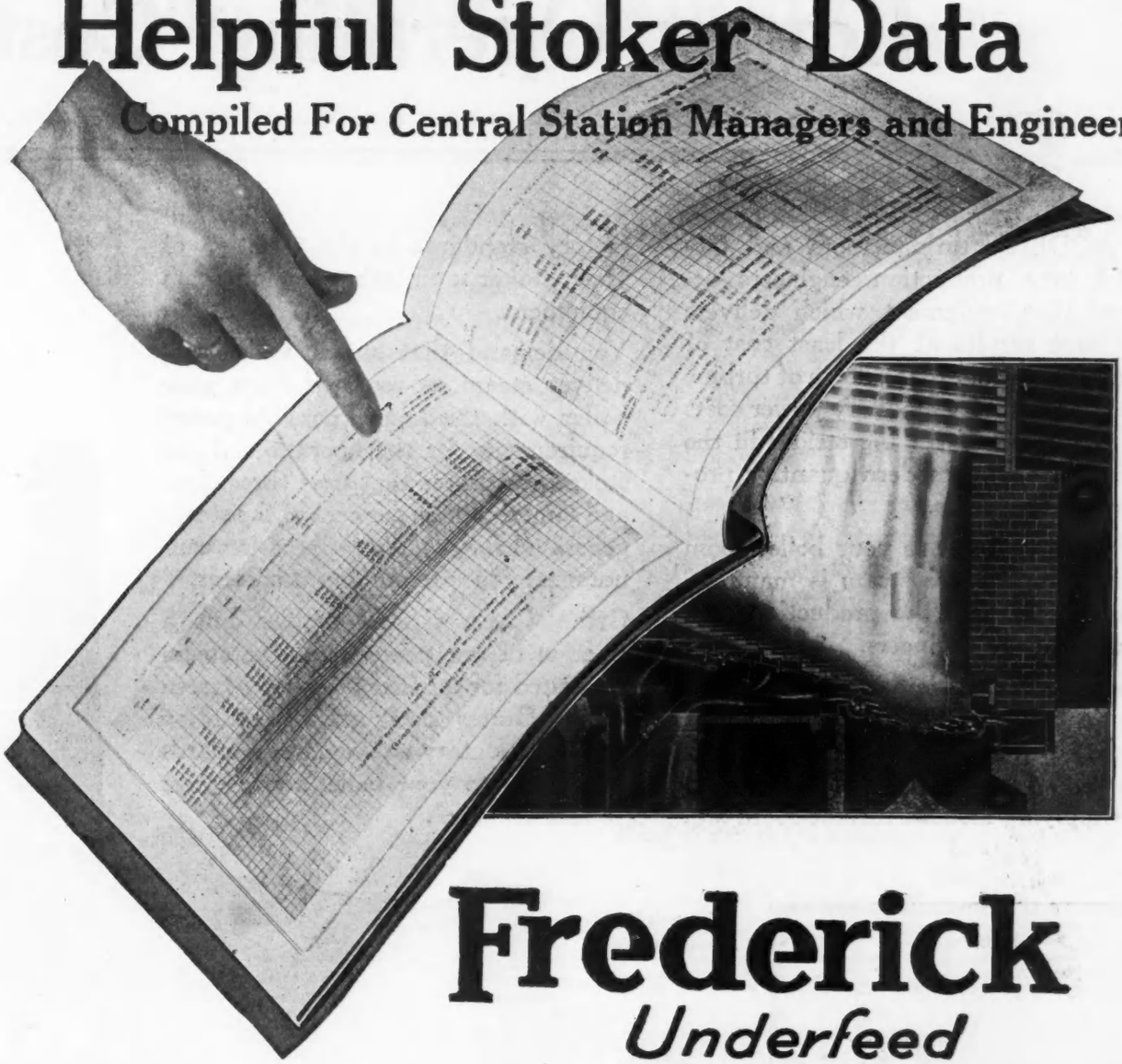
## Compiled For Central Station Managers and Engineers



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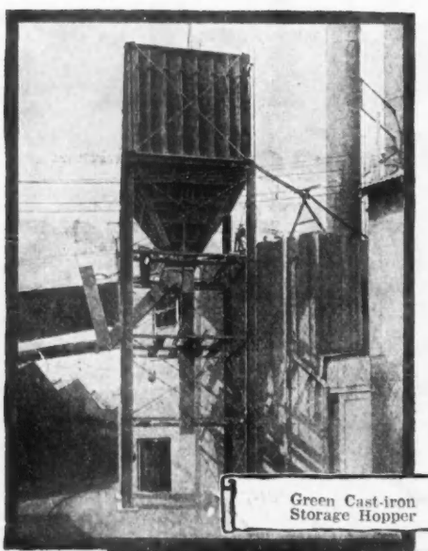
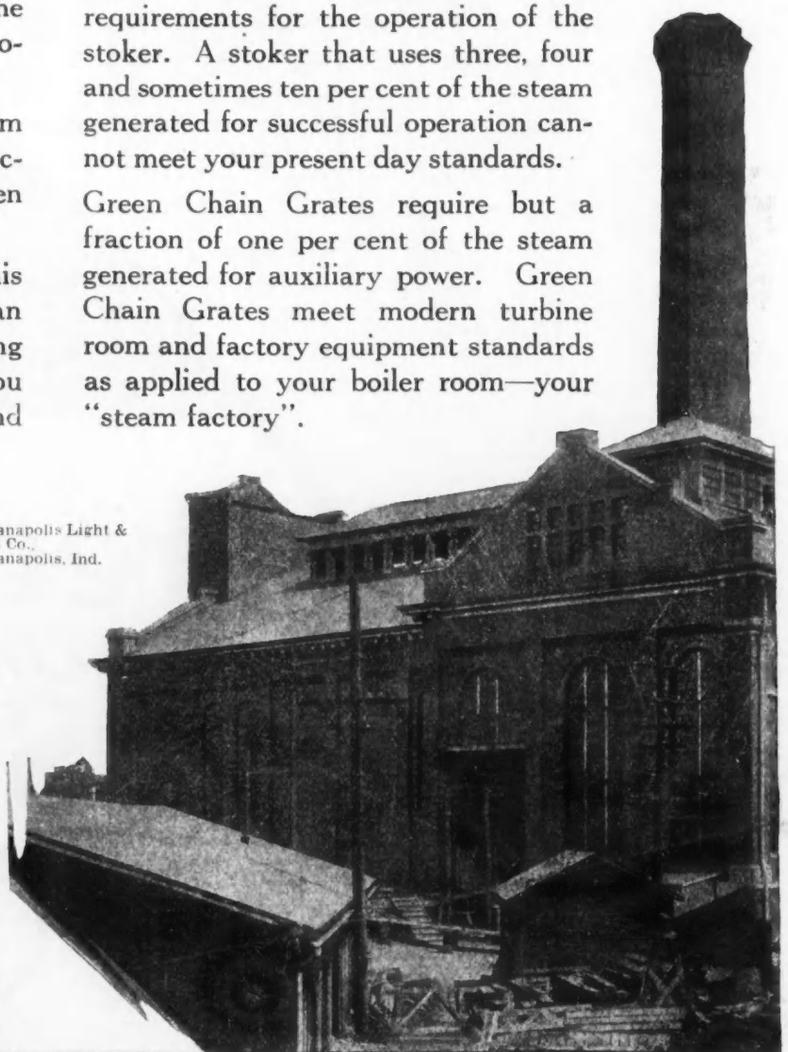
You demand that stoker which will deliver steam as required from your boiler with the lowest possible power requirements for the operation of the stoker. A stoker that uses three, four and sometimes ten per cent of the steam generated for successful operation cannot meet your present day standards.

Green Chain Grates require but a fraction of one per cent of the steam generated for auxiliary power. Green Chain Grates meet modern turbine room and factory equipment standards as applied to your boiler room—your "steam factory".



Green Cast-iron Storage Hopper



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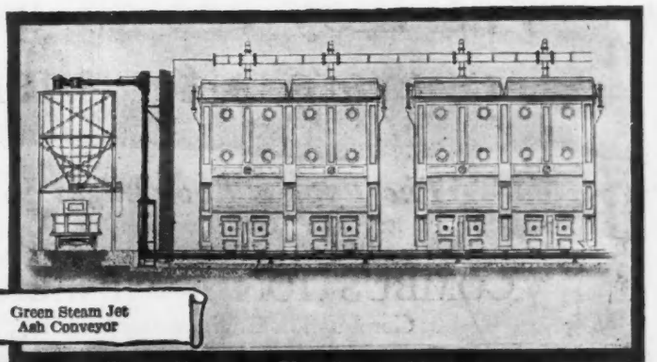

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Chain Grate Stokers, Ash Conveyors, Cast-iron Hoppers, Sealflex Arches, Pressure Water-backs

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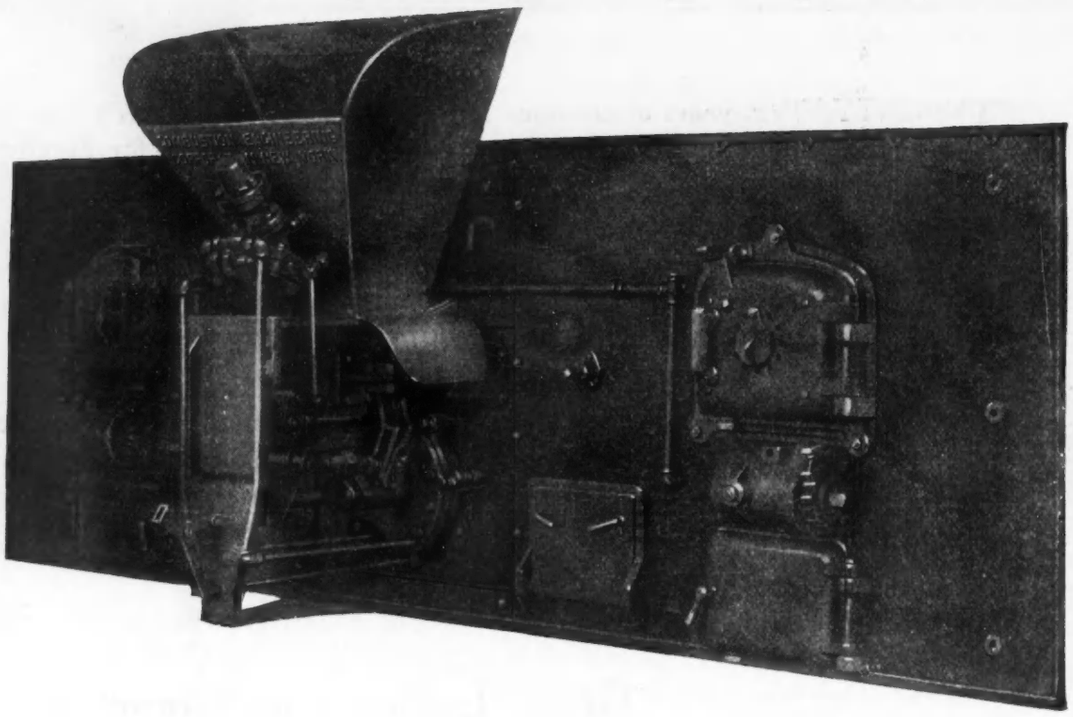

# TYPE E STOKERS

## are as simple and easy to install as they are to understand and operate after their installation.

*The Type E Book might do as well. Send for it.*

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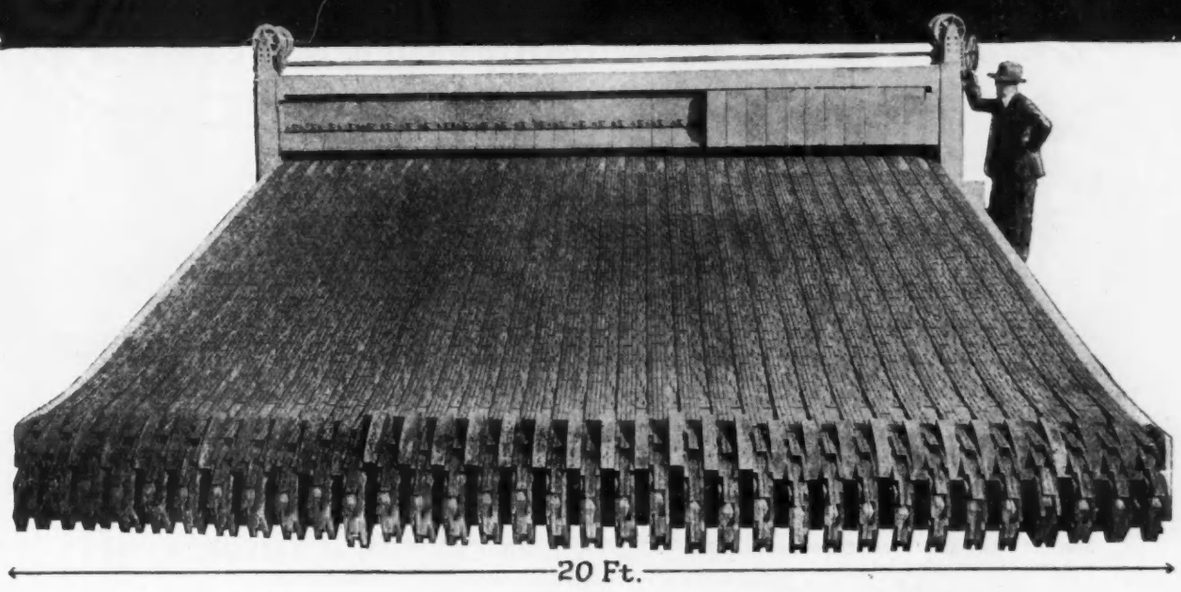


Pictured above is a 1200 H. P. STOWE STOKER—the largest single unit ever built on the conveyor feed principle. This stoker was designed to develop 300% of rating, and is now installed in the plant of the Central Illinois Light Co., Peoria, Ill., where it is giving excellent service.

You can get a single STOWE STOKER in sizes up to 1500 H. P. Think of being able to supply your 1500 H. P. Boiler with a forced-draft, conveyor-feed stoker in *one* large unit!

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When one considers first, the many striking features and advantages of the STOWE STOKER, and then, the marked simplicity of this mechanism, the realization comes that here is a truly great *achievement* in mechanical equipment design. Better write for the details.

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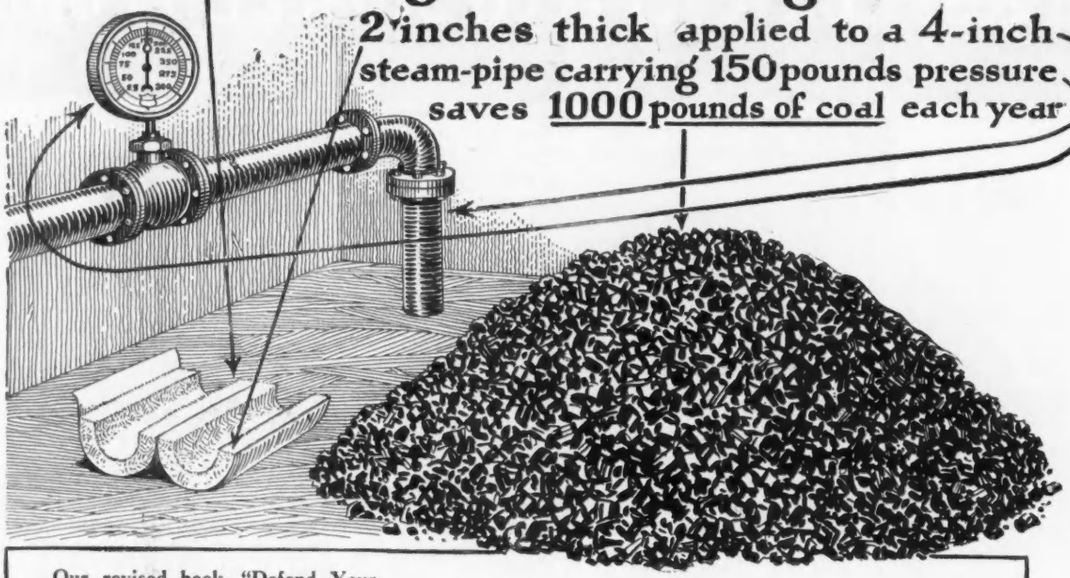

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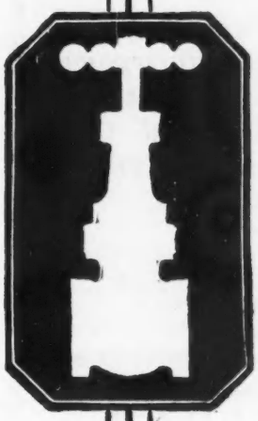
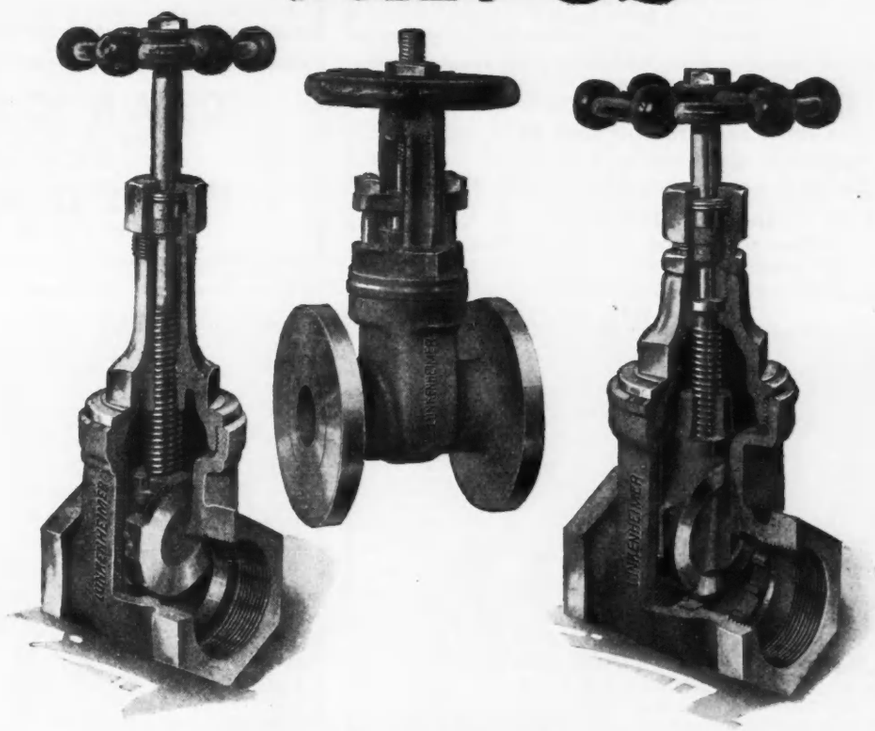


# LUNKENHEIMER
## *Bronze Gate Valves*



**LUNKENHEIMER BRONZE GATE VALVES remain tight under extreme operating conditions because the design is correct, the material is the well known LUNKENHEIMER "Valve-Bronze" and they are made with the skill which characterizes all LUNKENHEIMER Products.**

**The "double taper wedge seat" construction embodied in LUNKENHEIMER Bronze Gate Valves has proved its practicability. In addition to tightness, it insures ease of operation, minimum wear and consequent long service life.**

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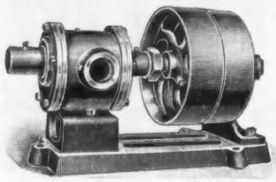

for Heavy or Light Liquids 15 to 400 Gal. per M.

Pressure up to 100 lbs.

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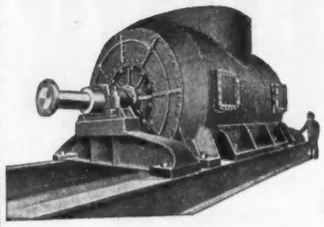

*High Speed*
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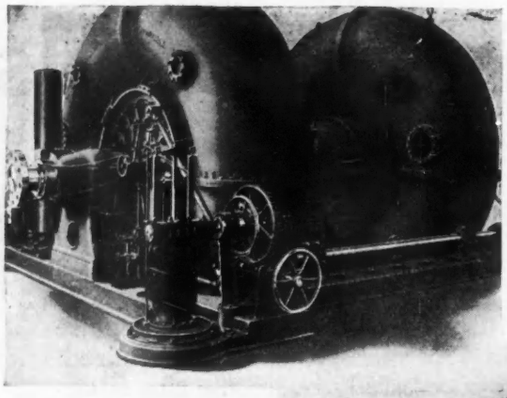
## *The Indication of Progress*

When height of head records for reaction turbines were recently broken by the 25,000 HP., 800-ft. head units in Southern California Edison Company, Kern River No. 3 plant, engineering passed an important milestone. High head hydroelectric developments have generally been regarded as limiting the turbine installations to the impulse type of units, though the advantage of reaction turbines for such projects were realized. The courage and ability of PELTON engineers have successfully overcome this situation and have made reaction turbines available for heads higher than ever before thought possible.

PELTON reaction turbines in large sizes, for heads above 800 ft., are not experiments. The knowledge of turbine construction which this organization has gained during its thirty-five years of successful activity makes it possible to achieve such outstanding results. Projects which require hydraulic turbine units of highest standards, capable of delivering constant service under all conditions over a long period of time, are most susceptible to PELTON turbines.

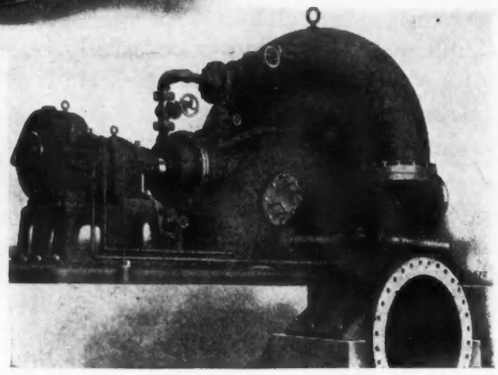
*Bring your problems to PELTON engineers for solving.*



6,000 *H.P. turbines installed in* 1913 *in Portland Railway & Light Co. plant, Portland, Ore.*

*Speed* 240 *R.P.M., head* 80 *ft.; efficiency* 87%.

# Worthington Hydraulic Turbines



8,000 *H.P. turbines installed in* 1906 *for City of Seattle, Wash.*

600-*ft. head*—600 *R.P.M.*

## Wheels of Progress

THE central station industry—alive to every opportunity of economical power production is probably displaying more interest in hydraulic power development than any other at this time. It is only natural, therefore, that Worthington should keep up with the industry it has served for so long and should encourage hydraulic power development by making water wheels.

The line of turbines developed by Worthington is adapted to central station or general industrial use; for all heads, high, low or medium. The Worthington turbine in addition to the Victor line of wheels taken over by Worthington from the Platt Iron Works enable the Worthington Pump and Machinery Corporation to handle any water wheel installation or problem that may arise.

**WORTHINGTON PUMP AND MACHINERY CORPORATION**
*Executive Offices:* 115 Broadway, New York City
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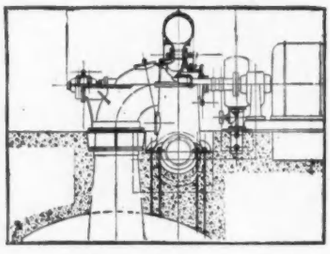


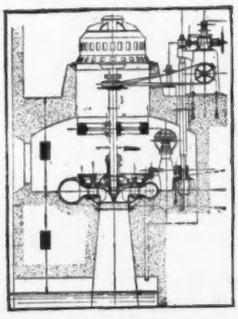
### Horizontal Single Discharge Turbine

This type is used only on higher heads—usually over 50 feet. The horizontal turbine has the advantage of accessibility. It is most applicable where a natural solid foundation exists and little concrete work is necessary.

Substructures for horizontal turbines are simple and when combined with a good, natural foundation the over-all cost of the power house is kept low.

### Vertical Cast-iron Spiral Flume Turbine

In general the advantages of the vertical turbine are: More favorable draft tube conditions and low mechanical losses, which make for greater hydraulic efficiency.



For heads below 30 feet an open flume is usually used. Up to about 45 feet head the concrete spiral flume is suitable.

For heads over 45 feet the flume should be cast iron, as shown, instead of concrete to withstand the pressure.

Where, on account of the power house site, the excavation and foundation are necessarily costly the vertical turbine effects a saving in cost of the substructure. For this reason it is sometimes selected in preference to the horizontal turbine.

P3

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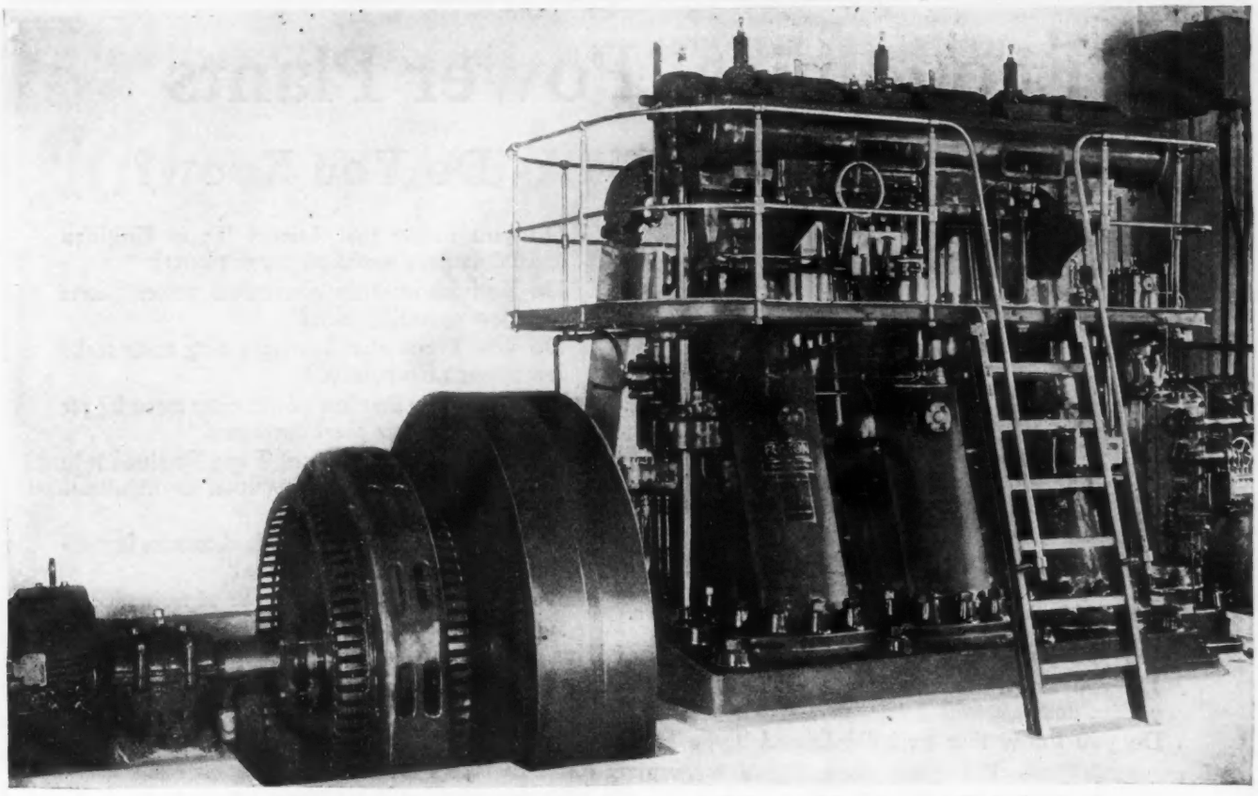


# A Power Problem of Fuel Waste Solved

An end long sought by builders of prime movers is a power plant which operates at high efficiency at fractional loads — a plant with a fuel economy that is constant over all loads.

In the Fulton Diesel Oil Engine this great end is fully attained. Fuel consumption is reduced automatically in proportion to the load, with only a negligible increase in consumption per net horsepower at any point in the entire range of load.

This fact makes the Fulton Diesel more economical in the use of fuel per net horsepower than any other type of prime mover. And this economy is independent of the human element, for, excepting the operations in starting and stopping, the engine is self-controlled and automatic in its functions.

***Facts to Remember About the Fulton Diesel***

A compact self-contained power plant. For all power purposes in units from 150 to 1,000 horsepower. In most cases shows clear savings of two-thirds over fuel consumption under boilers.

Thermal efficiency: Steam—15% maximum. Diesel—36% net. Fuel consumption in direct proportion to load. Uses cheap fuel. Constant readiness for operation without stand-by losses. Quick and easy starting. Economy independent of size. Long life with constant efficiency. Easily operated and maintained by any competent steam engineer.

*Our new bulletin, No. 801, describing and illustrating the Fulton Diesel Engine and containing other valuable information, will be mailed upon request.*

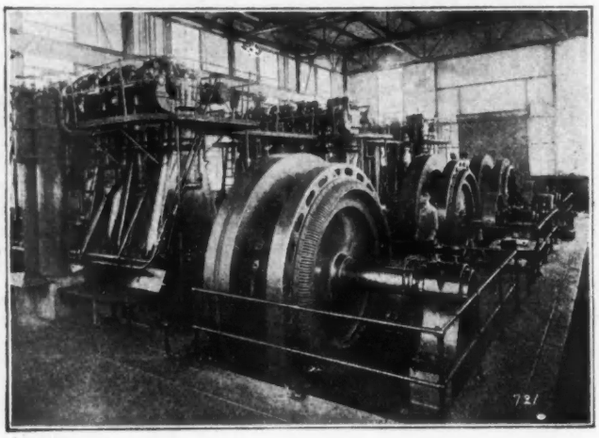
## FULTON IRON WORKS COMPANY, ST. LOUIS, U. S. A.

*Successful Engine Builders for 69 Years*

*Branch Offices:* New York—82 Wall St., Cuba, Havana—401-402 Banco Nacional.

# FULTON DIESEL ENGINES

# Economical Power Plants



3—500 *B.H.P. Engines in a modern Central Power Station.*

## Do You Know?

**Do you know** that **Diesel Type Engines** make the most economical power plants?

**Do you know** that economical power plants have low operating costs?

**Do you know** that low operating costs make low power rates possible?

**Do you know** that low power rates mean bigger business for power plant operators?

**Do you know** that **Diesel Type Engines** help make profits in close competition in industrial plants?

**Do you know** you cannot afford to miss investigating **Diesel Type Engines?**

**Do you know** that we may be of assistance to you?

**Do you know** that we are the largest builders of **Diesel Type Engines** in America?

**Do you know** that we have over 100,000 B.H.P. in **Diesel Type Engines** in operation at the present time?

**Do you know** that we build **Diesel Type Engines** in sizes from 100 B.H.P. to 2000 B.H.P.?

WRITE US

**McINTOSH & SEYMOUR CORPORATION**
Main Office and Works: AUBURN, NEW YORK

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**AMERICAN DESIGNERS AND BUILDERS OF DIESEL ENGINES SINCE 1898**

**BUSCH-SULZER**

**STATIONARY**
**120 TO 3300 B.H.P.**
**MARINE**
**600 TO 3000 S.H.P.**

**BUSCH-SULZER BROS. - DIESEL ENGINE CO., St. Louis, U. S. A.**
NEW YORK, 60 BROADWAY SAN FRANCISCO, RIALTO BLDG.

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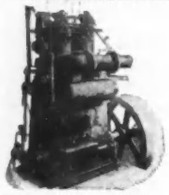

**"Taylor Principle" OIL ENGINES**

Are as simple in design and operation as a steam engine, with regulation within 2%. Cheap, reliable power from all size units 10 to 6000 H. P.

*Send for Bulletin 75.*

**Taylor Machine Co., Kimball Bldg. Chicago**

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**Compare Them**

The faint light of a candle and the strong rays of a searchlight. They represent the comparative efficiency of other ways of finding what you want and advertising for it in the

**SEARCHLIGHT SECTION**

Employment Equipment Business Opportunities

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# THE BABCOCK & WILCOX COMPANY

85 LIBERTY STREET, NEW YORK

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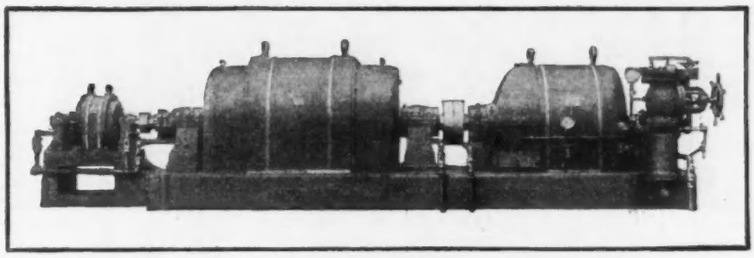
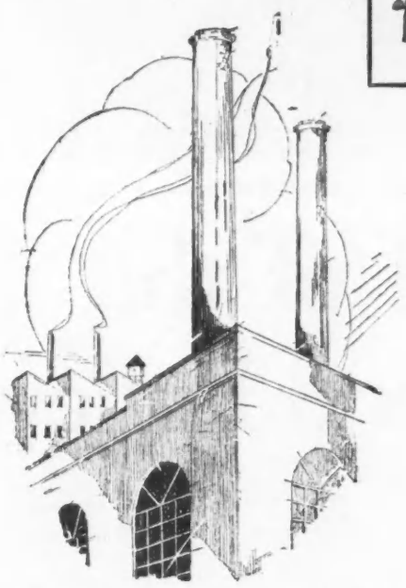
TO PRODUCE UNFAILING POWER ECONOMICALLY

# Ridgway Turbo-Alternators
## increasing power output 60% to 100%





*Ridgway Turbo-Alternators are especially adapted to large industrial plants and central stations.*

FOR additions to existing power plants in which there are non-condensing engines which are to be retained in service, a low or mixed pressure turbine is a good investment as it will increase the power output from 60% to 100%, using only the engine exhaust. If the supply of exhaust steam is variable or possibly will be insufficient, the mixed pressure turbine will take enough high pressure steam to maintain speed and carry the load, or will carry full load on high pressure steam only.

Ridgway turbines have especially large running clearances, simple, closely regulating governors and highly reliable and effective lubricating systems.

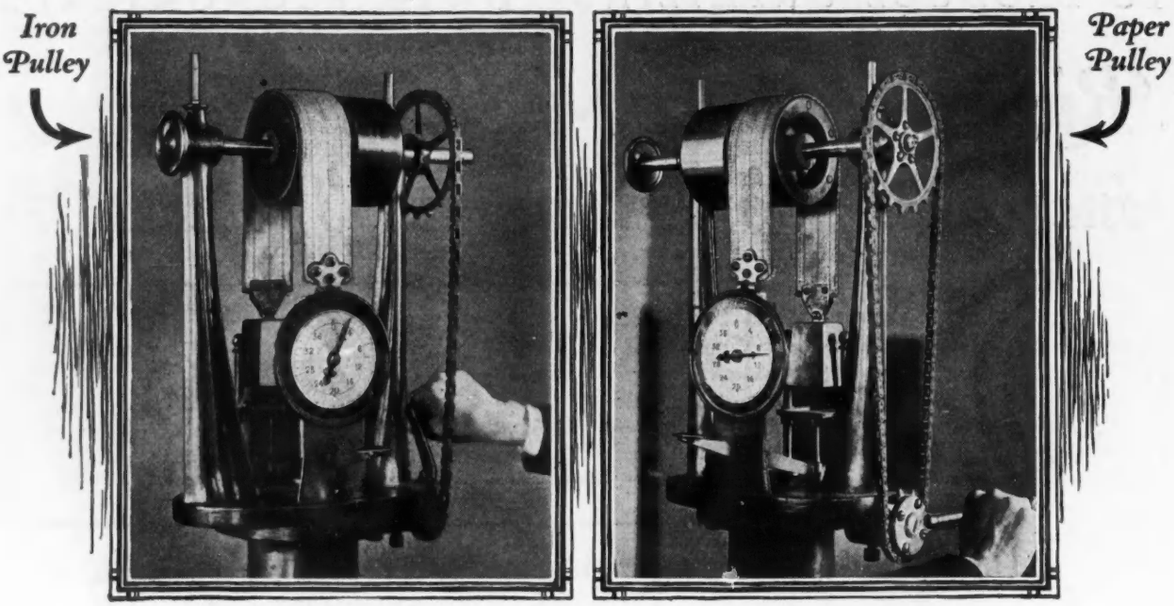
*Interesting Bulletins Free*

*Our latest bulletins cover the following subjects: Center-Crank Single-Valve Engines, Side-Crank Single and Four-Valve Engines, Unaflow Engines, Alternating-Current Generators, Direct-Current Generators, Motor-Generator Sets, Turbo-Generator Sets. Ask for the ones that interest you!*

RIDGWAY DYNAMO & ENGINE CO.
106 Electric Avenue, Ridgway, Pa.
Branch Offices in all Principle Cities

# RIDGWAY
## POWER UNITS

621




Iron Pulley Pulls 3 lbs. ROCKWOOD Pulls 9 lbs.

# Here's Proof of the "Pull" in Rockwood Pulleys

*Pictured above* is a simple test which clearly demonstrates why Rockwood keeps belt slip down to a *fraction* of what it is on iron pulleys.

An ordinary belt, with a weight on the end to hold it taut, is attached to a registering dial. Two pulleys—one an iron and one a Rockwood—are mounted side by side on the same shaft. Turning a crank revolves the pulleys.

When the crank is turned with the belt on the iron pulley, the dial registers 3 lbs.

You see what happens when the crank is turned *at the same rate of speed*, with the belt on the Rockwood pulley. The dial registers 9 lbs.—*three times as much grip or pull as the iron pulley!*

***Is it any wonder that electrical superintendents of big industrial plants everywhere won't have anything but Rockwood Paper Pulleys on their motors?***

THE ROCKWOOD MANUFACTURING COMPANY
1947 English Avenue, Indianapolis, U.S.A.

***Rockwood Paper Pulleys—***

1. Reduce slippage
2. Decrease belt tension
3. Transmit more power
4. Lower total cost of drive due to narrower belts

*(Section removed to show construction)*

In every city there is an active demand for Rockwood Paper Pulleys. We want one big jobber in each industrial center to carry a stock of pulleys for the trade. If there is no stock in your territory, write us at once.

All the Power—All the Time

ROCKWOOD PULLEY SERVICE

Uniform Quality
Motor and Generator
Brushes for
Central Station Units

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SAGINAW, MICH.
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FRANCKE FLEXIBLE COUPLINGS For Direct-Connected Machinery Shafts
Smith & Serrell, 36 Central Ave., Newark, N. J.
PINTITE RIGID COUPLINGS For Line Shafting
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Commutators and Commutator Segments
for Electric Starters and Lighters and all other types of D. C. Motors.
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Ansonia, Conn.

It doesn't tear out

Bristol's Steel Belt Lacing for repairing woven and rubber belting is *better* and *safer*. The points of the lacing are set so far back from the joints that when they are clinched they bind the fibre firmly, and don't tear out.

TRADE MARK
BRISTOL'S
REG. U. S. PAT. OFFICE.

Patent Steel Belt Lacing

comes in straight and staggered point style and in many sizes. Highly successful for over 30 years on all kinds of belting. Instantly applied with a hammer.

*Write for Catalog L-712.*

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Keep Motors and Generators at Highest Efficiency All the Time

OCCASIONAL use of the Ideal Commutator Resurfacer enables you to do just that. It's applied at full load and smooths off the grooves, high bars and mica in a few minutes. No interruption in service.

The net result is elimination of sparking, substantial power saving and greatly reduced commutator maintenance costs.

The Ideal, unlike natural stone, is a *known quantity*—a manufactured abrasive block of absolutely uniform cutting properties. It will not fill up with copper, or wear smooth, and, being non-metallic, won't cause short circuits. Always takes hold. Lasts longer.

Used on D. C. commutators or A. C. collector rings.
Why not try it out at our expense? Read the offer below.

IDEAL COMMUTATOR DRESSER CO.
3221 Sheffield Avenue, Chicago

The IDEAL COMMUTATOR RESURFACER

Not a natural stone—a manufactured abrasive block of uniform cutting properties.

*Send Coupon for Free Trial*

IDEAL COMMUTATOR DRESSER CO. E.W.6-25-21
3221 Sheffield Avenue, Chicago

Gentlemen: Please send me an Ideal Commutator Resurfacer for free trial. If I like it I'll pay for it. If I don't like it, I will return it—the trial will have cost me nothing. I want to use it on equipment with approximate r. p. m., width, diameter and clearance as follows:

Approx. R. P. M. ..... Diameter of Commutator or Ring .....
Approx. width of Commutator or Ring surface .....
Approx. distance between brush sets ..... Condition .....
Collector Ring or Commutator material .....
My name is ..... Position .....
Company ..... Company address .....
City ..... State .....

1-hp. Motor Geared to a Band Saw

Century

Repulsion Start Induction

## SINGLE PHASE MOTORS

possess a distinctive ability to render satisfaction to their operators in dirty and dusty surroundings.

Ratings—1/10 to 40 H.P.

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*Sales Offices in Principal Cities*

## Do You Use Compressed Air? Yes?

## Then You Have Use for a Branford Cleaner and Sprayer Nozzle

This device clamps directly to the air hose, while a nipple permits its use for spraying varnish, oil, paint or cleaning fluids wherever wanted. Nozzle and nipple attachments can be removed so that it may be used to blow out and clean machines of all kinds. The quick acting hand valve gives complete control.

**Cleaner complete with 12-in. extension and hose boxed, $4.00 net. F. O. B. Branford, Conn., U. S. A.**

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**Maple Street Plant**
**Branford, Conn.**

## Eliminate Vibration

### Secure perfect Balance with speed and economy

All turbine rotors, armatures, crankshafts, flywheels, etc., should be accurately balanced both statically and dynamically.

### Use the Olsen-Carwen Static-Dynamic Balancing Machine

***Made in many sizes to test from the smallest to the largest rotor. Write for pamphlet.***

**Also manufacturers of all the Olsen Universal and Special Testing Machines for determining the Physical strength and qualities of materials.**

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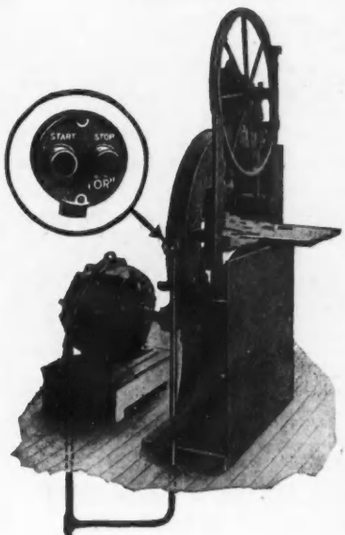



# Automatic Starting of Motors in Intermittent Service

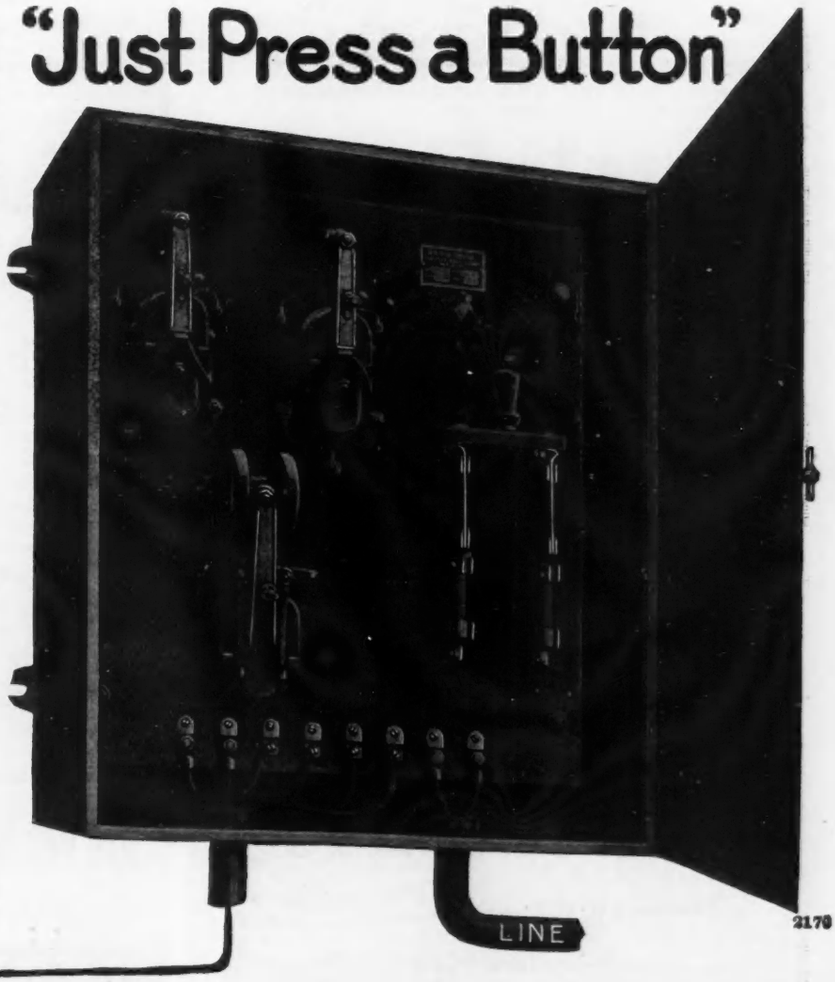
The band saw here shown is part of the pattern-shop equipment of a large manufacturing plant, and like most pattern-shop tools it is used intermittently. In order to take full advantage of the intermittent load, such machines should be equipped with individual motors and automatic starters.

## The Monitor System

of automatic control allows the operator to start and stop the motor without trouble and without subjecting either the motor or the machine to any excessive strains, such as might be caused by repeated stopping and starting with a manual starter or by shifting belts.

In an installation of this kind the machine and its motor run only when used which results in a considerable saving in energy as well as a proportionate increase in the life of both the machine and the motor. Then, too, with an automatic starter the operation of starting is carried out in the shortest time consistent with proper limitation of armature current and starting strains in the machine. It meets the ideal conditions every time, and this alone results in an important prolongation of the life of machinery so controlled.

## "Just Press a Button"




Let us send Bulletin 1001 describing the Monitor System of Machine Tool Control.

**Monitor Controller Company**

**Baltimore, Md.**

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| New York | Pittsburgh | Philadelphia |
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**For Dependability**

*Practically Indestructible Rotor.*
*"Over-capacity" self-aligning ball bearings.*
*Extra sturdy shaft of high carbon steel.*
*Protected ventilating ducts.*
*Exceptionally small end bracket openings.*

ELECTRO DYNAMIC COMPANY
BAYONNE NEW JERSEY

E-D Induction Motors: ½ to 200 H.P.
E-D D.C. Interpole Motors: ¼ to 300 H.

*Write for an E-D Bulletin*

***Low-Upkeep* MOTORS**

Twenty-eight years' experience making ROTHMOTORS has resulted in an enviable record for motors of high efficiency and low maintenance cost. That ROTHMOTORS are dependable—serving long and hard, day after day—is proved by many of the largest motor users in the country. Daily, uninterrupted service without repairs for as long as ten years has been achieved by more than one ROTHMOTOR.

*Write for full information*

**Roth Brothers & Co., 1400 West Adams St. Chicago, Ill., U. S. A.**

# CROCKER-WHEELER MOTORS

**CROCKER-WHEELER CO., Ampere, N. J.**

# Emerson Motors—Fans

A.C. and D.C. motors 2 hp. and smaller in many jobbers' stocks.

Special types developed for makers of motor-operated machines.

Emerson and Northwind fans sold by jobbers in every section.

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Eastern Office: 50 Church St., New York

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**ALTERNATING OR DIRECT CURRENT**

***Constant or Variable Speed ¼ to 50 HP.***

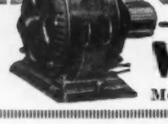
**B. A. WESCHE ELECTRIC CO.**
**CINCINNATI, OHIO**
Eastern Sales Office—145 W. 18th St., New York, N. Y.

# COLONIAL

**Fans—Motors—Generators**

FAN & MOTOR CO. WARREN, O.

# SERVICE



**—real and helpful, is behind every**

**WATSON Electric MOTOR**

**Mechanical Appliance Co., Milwaukee, Wis.**

TYPE "TR"

# 40° TRIUMPH

**Self Start**
**AUTOMATIC MOTORS**
No compensator required
**THE TRIUMPH ELECTRIC CO.**
Cincinnati
*Builders of Motors since 1892*

*"True in the Long Run"*

**Engineers Planning Power Transmissions**
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Oil Engines—1½ H.P. to 300 H.P.
Pumps—Steam-Power-Centrifugal
Electric Motors and Dynamos
Light Plants Fairbanks Scales

**FAIRBANKS, MORSE & CO.**
Manufacturers, Chicago

We specialize in motors, ½ to 150 hp. constant and adjustable speed D.C.; squirrel cage and slip ring A.C.

**RELIANCE MOTORS**

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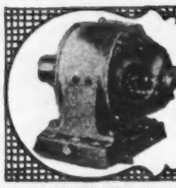
HIGH SPEED
# ARMATURE NOTCHERS
400 STROKES PER MINUTE
FERRACUTE MCH. CO., BRIDGETON, N. JERSEY, U.S.A.



**MARBLE-CARD MOTORS**
Builders of Direct Current Ball Bearing Commutating Pole Motors of ½ H.P. to 60 H.P. at Induction Motor Speeds.
Bulletin 200 contains complete information.
**Marble-Card Electric Company**
Gladstone, Mich.

*Built to a Standard*

# BURKE ELECTRIC CO.

ERIE, PA

**Motors, Alternators, Generators, Motor Generator Sets, Transformers, Arc Welding Equipment**

*Sales Offices:* Buffalo, Cleveland, Detroit, Erie, New York, Philadelphia, Pittsburgh
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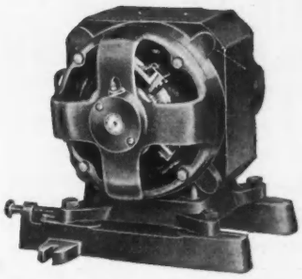
## BALDOR ELECTRIC CO.



- Ball Bearings
- Compact skeleton frame
- High starting torque
- Low starting current
- Horizontal commutator
- Enclosed shorting mechanism

**Single Phase Repulsion Induction Motors**

*Write factory for prices and catalog*

4351-55 Duncan Ave. St. Louis, Mo.

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Diehl
TRADE MARK

**Diehl Apparatus *of* Recognized Merit**

Direct and alternating current motors—direct current generators—motor generator sets—ventilating and exhaust fans—desk and ceiling fans—railway car fans.

**DIEHL MANUFACTURING COMPANY**
**Elizabeth, N. J.**

Boston Chicago New York Philadelphia

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Sturtevant
(REG U S PAT OFF.)

*Designers and Builders of*
Heavy Duty Direct Current Motors and Generators for General Purposes

**B. F. STURTEVANT COMPANY**
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## SERVICE

For fifteen years we have been designing and building fractional motors for the most critical buyers. Are you interested in having that new machine of yours equipped with a motor that will give uninterrupted service? Your answer will undoubtedly be yes.
Our engineering department will be pleased to make recommendations. No obligation.

**BODINE ELECTRIC COMPANY**
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Advance Motors
Single Phase
Induction Repulsion
¼ to 7½ hp.
Advance Electric Co., St. Louis, Mo.

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## KIMBLE FLR

KIMBLE MOTORS

Chain-controlled
Variable Speed, Reversible
Ventilating Fan

*Send for FLR Bulletin.*

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Peerless MOTORS

# Type "R"
## for
# Heavy Duty

For drives where it is necessary to start under heavy load the Type "R" Repulsion Induction Single Phase motors have proven their ability.

On Punch Presses, Shears, Air Compressors, etc., their high starting torque and rapid acceleration make them highly efficient.

No auxiliary starting equipment—just throw a D.P. Switch—that's all!

Sturdy construction under rigid shop methods and supervision is reflected in the "Peerless Service" they render under the hardest kind of operating conditions.

***You will be interested in Bulletin No. 200.***
***It tells the whole story of Type "R."***
***Send for it.***

**Peerless Electric Co.**
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# WHAT AND WHERE TO BUY

## Equipment, Apparatus and Supplies Advertised in this Issue with Names of Manufacturers and Distributors

**Readers interested in any articles not listed in these pages are cordially invited to inform us of their wants and every effort will be made to put them in touch with the proper manufacturers.**

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**Boiler Baffles**
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Crocker-Wheeler Co.
General Electric Co.
Ridgway Dynamo & Engine Co.
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Link-Belt Company

**Buildings, Steel**
Milliken Bros. Mfg. Co. Inc.
Riter-Conley Mfg. Co.

**Bus Bar Supports**
Delta Star Electric Co.
Electric Power Equipment. Co.
Elec'l Development & Machine Co.
General Electric Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

**Bushings**
Bound Brook Oil-Less Bearing Co.
National Fibre & Ins. Co.
National Metal Molding Co.

**Cable (See Wires and Cables)**

**Cable Accessories, End Bells and Racks**
Cope, T. J.
Electrical Development & Electrical Engineers Equip. Co.
Mach. Co.
General Elec. Co.
Hubbard & Co.
Standard Underground Cable Co.
Westinghouse Elec. & Mfg. Co.

**Cable End Bells**
G. & W. Elec. Spec. Co.

**Cable Splicing Joints**
Dossert & Co.
Frankel Connector Co.
Johns-Manville, Inc.

**Cable Winches**
Cope, T. J.

**Cabling Machinery**
American Ins. Machinery Co.
New Englang Butt Co.
United States Graphite Co.

**Cambric Tapes, Varnished Yellow and Black**
Irvington Varnish & Ins. Co.

**Casting**
International Nickel Co.

**Castings, Die**
Acme Die Casting Co.

**Chains, Silent Power Transmission**
Link-Belt Company
Morse Chain Co.

**Circuit Breakers**
Automatic Reclosing Circuit Breaker Co.
Condiit Elec'c Mfg. Co.
Cutter Co., The
General Electric Co.
Industrial Controller Co.
Pacific Electric Mfg. Co.
Roller-Smith Co.
Sangamo Electric Co.
Schweitzer & Conrad, Inc.
Sundh Elec. Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

**Clamps, Ground Connection**
Condit Elec'c Mfg. Co.
Dossert & Co.
Frankel Connector Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

**Clamps, Guy**
Hubbard & Co.

**Clamps, Insulator**
Clark Electric & Mfg. Co.

**Cleats**
Blake Signal & Mfg. Co.
Elec'l Development & Machine Co.
Imperial Porcelain Co.
National Metal Molding Co.
Pass & Seymour, Inc.
Thomas & Sons Co., R.

**Climbers**
Klein & Sons, Mathias

**Clips**
*Cable*
Condit Elec'l Mfg. Co.
Hubbard & Co.
*Testing*
Mueller Electric Co.

**Clusters**
Benjamin Elec. Mfg. Co.
Hubbell, Inc., Harvey

**Clutches**
*Friction*
Link-Belt Company

*Magnetic*
Cutler-Hammer Mfg. Co.

**Coal and Ash Handling Machinery**
Blaw-Knox Co.
Brown Hoisting Machinery Co.
Combustion Engineering Co.
Fuller-Lehigh Co.
Gleason & Co., J. L.
Green Engineering Co.
Hayward Co.
Link-Belt Company

**Cold Storage Systems**
Link-Belt Company

**Coil Winding Tools**
Electric Service Supplies Co.

**Coils, Armature, Field and Magnet**
Acme Wire Co.
Coto-Coil Co.
D. & W. Fuse Co.
Dudlo Mfg. Co.
Industrial Controller Co.
I. R. Nelson Company
Ward Leonard Electric Co.

**Coils, Choke**
Delta-Star Elec. Co.
Electric Power Equip. Corp.
General Electric Co.
Hi-Voltage Equipment Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

**Columns, Safety Water**
Lunkenheimer Company

**Combustion Engineers & Contractors**
Automatic Fuel Saving Co.

**Commutators**
Cameron Electric Mfg. Co.

**Commutator Stones**
Ideal Commutator Co.

**Commutator Truing Devices**
Jordan Bros.

**Condenser Papers**
Irvington Varnish & Ins. Co.

**Condensers**
Alberger Pump & Condenser Co.
Allis-Chalmres Mfg. Co.
Elliott Company
General Elec. Co.
Manistee Iron Works
Ward-Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.
Worthington Pump & Mchy. Corp.

**Condensers, Rotary Jet**
Manistee Iron Works

**Condensor Tubes**
American Brass Co.

**Conduit Fittings**
Chicago Fuse Mfg. Co.
Killark Elec. Mfg. Co.
Pass & Seymour, Inc.
Sprague Elec. Works

**Conduit Rods**
Cope, T. J.

**Conduits, Interior**
American Circular Loom Co.
National Metal Molding Co.
Sprague Elec. Works
Tubular Woven Fabric Co.

**Connectors and Terminals**
Dossert & Co.
Electric Power Equip. Corp.
Frankel Connector Co.
General Elec. Co.
Sherman Mfg. Co., H. B.
Westinghouse Elec. & Mfg. Co.

**Contact Rail Material**
Electric Service Supplies Co.

**Construction of Lighting and Power Equipment**
Woodward, Jr., George

**Control, Automatic Combustion**
Automatic Fuel Saving Co.

**Construction Engineering**
(See Directory of Engineers)
Foundation Co.

**Controllers, Feed Water**
Northern Equipment Co.

**Controllers, Motor**
Cutler-Hammer Mfg. Co.
General Electric Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Elec. Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

**Conveying Machinery (Coal Ashes, etc.)**
American Bridge Co.
Gleason & Co., J. L.
Green Engineering Co.
Link-Belt Company

**Cooling Ponds, Spray**
Spray Engrg. Co.
Yarnall Waring Co.

**Cord Adjusters**
American Vulcanized Fibre Co.
National Fibre & Ins. Co.

**Cord, Arc Lamp**
Samson Cordage Works

**Cord, Flexible**
Belden Mfg. Co.
Indiana Rubber & Ins. Wire Co.
Lowell Insulated Wire Co.
Rome Wire Co.

**Cord, Trolley**
Samson Cordage Works

**Couplings, Flexible**
Bartlett Hayward Co.
Smith & Serrell

**Couplings, Hose**
Chicago Pneumatic Tool Co.

**Couplings, Rigid (Shaft)**
Smith & Serrell

**Crane Motors**
General Electric Co.
Sprague Elec. Works
Westinghouse Elec. & Mfg. Co.

**Cranes**
*Traveling*
American Bridge Co.
Brown Hoisting Mchry Co
Maris Bros.
*Locomotive*
Brown Hoisting Mchry. Co.
Hubbard & Co.
Link-Belt Company

**Cross Arms**
American Bridge Co.
Hubbard & Co.
Riter-Conley Mfg. Co.
Thomas & Sons Co., R.
Western Electric Co.

**Crushes, Coal and Coke**
Link-Belt Company

**Cutouts**
Arrow Elec. Co.
Chicago Fuse Mfg. Co.
Condit Elec'l Mfg. Co.
D. & W. Fuse Co.
G. & W. Elec. Spec. Co.
General Electric Co.
Johns-Manville, Inc.
Metropolitan Device Corp.
Schweitzer & Conrad, Inc.
Wade, A. S.
Westinghouse Elec. Mfg. Co.

**Devices, Combustion Control**
Automatic Fuel Saving Co.

**Dish Washers**
Hugro Mfg. Co.

**Doors for Bins & Switch Compartments**
Elec'l Development & Machine Co.

**Draft Control**
Automatic Fuel Saving Co.

**Draft, Mechanical**
Engineer Co., The
Sturtevant Co., B. F.

**Drills**
*Brick*
Hubbard & Co.
*Portable*
Barnes Co., W. F., & John
Chicago Pneumatic Tool Co.

**Economizers, Fuel**
Sturtevant Co., B. F.

**Educational Institutions**
United Y. M. C. A. Schools

**Electromagnets**
Acme Wire Co.
Coto-Coil Co.
Ward Leonard Electric Co.

**Engine Trimmings**
Lunkenheimer Company

**Engines, Internal Combustion**
Allis-Chalmers Mfg. Co.
Busch-Sulzer Bros. Diesel Eng. Co.
Chicago Pneumatic Tool Co.
Fairbanks, Morse & Co.
Fulton Iron Works
Lombard Governor Co.
McIntosh & Seymour Corp.
Western Machinery Co.
Worthington Pump & Machy. Corp.

**Engines, Oil**
De La Vergne Machine Co.
Midwest Engine Co.

**Engines, Steam**
Allis-Chalmers Mfg. Co.
American Blower Co.
Chicago Pneumatic Cool Co.
Elec'l Development & Machine Co.
Ridgway Dynamo & Engine Co.

Motors driving domestic and manufacturing refrigerating machinery.

Wagner Motors are 40° Motors

# A Few Cold Facts on Motor Quality

are found in the applications of Wagner,Quality motors in the refrigerating processes, both in the big ice manufacturing plants and in private residences. The types of motors used vary from little 2-hp. squirrel-cage motors to 220-hp. wound rotor polyphase motors driving commercial sizes of ammonia compressors.

The fact is, Wagner,Quality motors, single-phase and polyphase, have proved the advantage of Quality drives in widely diversified industries throughout the world. And they have done this because they **are** of a quality that insures steady, reliable power. Moreover, Wagner motors are made in a **variety** of types that permits of fitting the motor to the work—not the work to the motor.

Bulletins 1274 (Single-phase) and 1224 (Polyphase) will be sent upon request.

**Wagner Electric Manufacturing Company**

**Saint Louis, Missouri**

2584

**Evaporators, Water**
Griscom-Russell Co.

**Excavating Machinery, Motor-Driven**
Hayward Co.

**Experimental Apparatus**
Biddle, James G.
Leeds & Northrup Co.
Roller-Smith Co.

**Factory Equipment, Steel**
David Lupton's Sons Co.

**Fan Motors**
Century Elec. Co.
Colonial Fan & Motor Co.
Diehl Mfg. Co.
Emerson Elec. Mfg. Co.
General Electric Co.
National Screw & Tack Co.
Peerless Electric Co.
Robbins & Myers Co.
Sprague Elec. Works
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

**Fans (Exhaust and Ventilating)**
American Blower Co.
Century Electric Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Emerson Elec. Mfg. Co.
General Electric Co.
Kimble Electric Co.
Marathon Electric Co.
Mechanical Appliance Co.
National Screw & Tack Co.
Robbins & Myers Co.
Sprague Elec. Works
Sturtevant Co., B. F.
Westinghouse Elec. & Mfg. Co.

**Fans, Turbine Driven**
Terry Steam Turbine Co.

**Feed Water Heaters**
Alberger Pump & Condensor Co.
Elliott Company
Griscom-Russell Co.

**Fibre (See Insulating Material)**

**Filters,**
*Oil*
Elliott Company
Hunt, Edward J.
*Water*
Elliott Company

**Financial**
Coal & Iron National Bank

**Fire Alarms**
Ostrander & Co., W. R.

**Fire Brick**
Green Fire Brick Co., A. P.

**Fire Clay, Cement and Mortar**
Green Fire Brick Co., A. P.

**Fire Extinguishers**
Johns-Manville, Inc.

**Fixtures, Adjustable Lighting**
American Fixture Co.

**Fixtures, Industrial Lighting**
St. Louis Brass Mfg. Co.

**Flashers**
Campbell Elec. Co.

**Flexible Tubing, Varnished . Yellow and Black**
Irvington Varnish & Ins. Co.

**Flumes, Iron**
Armco Iron Culvert & Flume Co.

**Foundations (for machinery)**
General Mach. Foundation

**Freezers, Ice Cream**
Whitney Co., F. E.

**Friction Tape and Cloths**
Johns-Manville, Inc.

**Furnace Blocks**
Drake Non-Clinkering Furnace Block Co.

**Furnace Contral Equipment**
Automatic Fuel Saving Co.

**Furnace Equip. Water Cooled**
Blaw-Knox Co.

**Furnaces**
Electric Furnace Const. Co.
Pittsburgh Electric Furnace Corp.

**Furnaces, Linings**
Green Fire Brick Co., A. P.
Johns-Manville, Inc.

**Furnaces, Pulverized Coal**
Combustion Engineering Co.
Fuller-Lehigh Co.

**Furnaces, Pulverized Coal**
Pulverized Fuel Equip. Corp.

**Fuses**
*High Tension*
Delta Star Elec. Co.
Electric Engineers Equip. Co.
Electric Power Equip. Co.
Hi-Voltage Equip. Co.
Johns-Manville, Inc.
Railway & Industrial Eng. Co.
Schweitzer & Conrad Co.
*Refillable*
Bussmann Mfg. Co.
Chicago Fuse Mfg. Co.
D. & W. Fuse Co.
Johns-Manville, Inc.
Monarch Refillable Fuse Co.
Trico Fuse Mfg. Co.
*Standard*
Bussmann Mfg. Co.
Chicago Fuse Mfg. Co.
Condit Elec'l Mfg. Co.
D. & W. Fuse Co.
General Electric Co.
Johns-Manville, Inc.
Killark Elec. Mfg. Co.
Metropolitan Device Corp.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Gas Holders**
Riter-Conley Mfg. Co.

**Gauges, Recording**
Bristol Co., The
Foxboro Co.
Yarnall-Waring Co.

**Gears**
Diamond State Fibre Co.
Cleveland Worm Gear Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

**Gears, Herringbone and Reduction**
Foote Bros. Gear & Machine Co.

**Gearing, Silent, Flexible**
Link-Belt Company
Morse Chain Co.

**Generators**
Burke Electric Co.

**Generating Sets**
General Electric Co.
Sturtevant Co., B. F.
Westinghouse Elec. & Mfg. Co.

**Globes, Shades, etc.**
National Screw & Tack Co.

**Governors**
*Pump*
Northern Equipment Co.
*Oil Pressure*
Lombard Governor Co.

**Grates**
McClave-Brooks Co.

**Grease Extractors**
Elliott Company

**Ground Clamps**
Sherman Mfg. Co., H. B.

**Grounds, etc.**
Paragon Electric Co.

**Hair Dryers**
Sheldon Elec. Co.

**Hangers**
*Catenary*
International Nickel Co.
*Cable*
Condit Elec'l Mfg. Co.
Hubbard & Co.

**Head Gates**
American Bridge Co.

**Heaters, Industrial**
Aetna Electric App. Co.
Cutler-Hammer Mfg. Co.
Electric Sales Service Co.

**Heating and Ventilating Systems**
Sturtevant Co., B. F.

**Heating Devices**
Cutler-Hammer Mfg. Co.
Electric Sales Service Co.
Prometheus Elec. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

**Hoists**
Allis-Chalmers Mfg. Co.
Sprague Elec. Works
*Electrical and Steam*
Link-Belt Company
Sprague Elec. Works
*Pneumatic*
Chicago Pneumatic Tool Co.

**Hose, Air**
Chicago Pneumatic Tool Co.

**Indicators, Speed**
Biddle, Jas. G.
Roller-Smith Co.
Thomson-Levering Co.

**Ice Making Machine**
Automatic Refrigerating Co.

**Instrument Transformers**
General Electric Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec'l Inst. Co.

**Instruments**
*Boiler Room*
Automatic Fuel Saving Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Spray Engineering Co.
Westinghouse Elec. & Mfg. Co.
Worthington Pump & Mach. Co.
Yarnall-Waring Co.
*Graphic*
Biddle, James G.
Bristol Co., The
General Electric Co.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
*Indicating*
General Electric Co.
Jewell Elec'l Instr. Co.
Johns-Manville, Inc.
Norton Electrical Instru. Co.
Rawson Elec'l Instrument Co.
Roller-Smith Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec'l Inst. Co.
*Integrating*
Biddle, James G.
Duncan Electric Mfg. Co.
General Electric Co.
Roller-Smith Co.
Rawson Elec'l Instrument Co.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
*Repairing and Testing*
Leeds & Northrup Co.
*Scientific and Testing, Service*
Biddle, James G.
National Fibre & Ins. Co.
General Electric Co.
Leeds & Northrup Co.
Metropolitan Device Corp.
Rawson Electrical Instru. Co.
Research Laboratories of G. E.
Roller-Smith Co.
Thomson-Levering Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec'l Inst. Co.

**Insulating Machinery**
American Ins. Machinery Co.
New England Butt Co.

**Insulating Material**
*Cement*
Condensite Co. of America
*Compounds, Paints and Varnishes*
Barrett Co., The
Garfield Mfg. Co.
General Bakelite Co.
General Electric Co.
General Insulate Co.
Habirshaw Elec. Cable Co.
Irvington Varnish & Ins. Co.
Johns-Manville, Inc.
Mica Insulator Co.
Minerallic Elec. Co.
Mitchell Rand Mfg. Co.
Packard Electric Co.
Rogers-Pyatt Shellac Co.
Sherwin-Williams Co.
Westinghouse Elec. & Mfg. Co.
*Comp. Cloth and Paper*
General Electric Co.
Hope-Webbing Co.
Irvington Varnish & Ins. Co.
Mica Insulator Co.
Westinghouse Elec. & Mfg. Co.
*Fibre*
American Vulcanized Fibre Co.
Continental Fibre Co.
Diamond State Fibre Co.
Fibre Conduit Co.
National Fibre & Ins. Co.
Schoonmaker Co., A. F.
Wilmington Fibre & Spec. Co.
*Lava*
American Lava Corporation
Steward Mfg. Co., D. M.
*Mica*
Mica Insulator Co.
Rogers-Pyatt Shellac Co.
*Molded*
Condensite Co. of America
Cutler-Hammer Mfg. Co.
Formica Insulation Co.
Garfield Mfg. Co.
General Bakelite Co.
Hopewell Ins. & Mfg. Co.
International Insulating Corp.
Johns-Manville Co., Inc.
Northern Industrial Chemical Co.
Redmanol Chem. Prod. Co.
*Paper*
Barrett Co., The
Diamond State Fibre Co.
Irvington Varnish & Ins. Co
Johns-Manville, Inc.
National Fibre & Ins. Co.
*Silk*
Irvington Varnish & Ins. Co.
*Slate*
Portland Monson Slate Co.
*Tape*
General Electric Co.
Hope-Webbing Co.
Johns-Manville, Inc.
Mica Insulator Co.
Mitchell-Rand Mfg. Co.
Okonite Co.
Packard Electric Co.
Res-Pro Insulating Co., Inc.
Westinghouse Elec. & Mfg. Co.

**Insulator Pins**
Hubbard & Co.
Thomas & Sons Co., R.

**Insulators**
*Glass*
Hemingray Glass Co.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
*Porcelain, Composition*
Electric Power Equip. Corp.
General Electric Co.
General Insulate Co.
Hopewell Ins. & Mfg. Co.
Imperial Porcelain Works
Jeffrey-Dewitt Co.
Johns-Manville, Inc.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
Mica Insulator Co.
Ohio Brass Co.
Pittsburgh High Voltage Insulator Co.
Porcelain Insulator Corp.
Thomas & Sons Co., R.
Westinghouse Elec. & Mfg. Co.
*Post Type*
Delta Star Electric Co.
Elec'l Development & Machine Co.

**Irons, Electric**
Cutler-Hammer Mfg. Co.
Westinghouse Elec. & Mfg. Co.

**Ironing Machines**
Hugro Mfg. Co.

**Lamp Coloring**
McGill Mfg. Co.

**Lamp Guards**
Hubbell, Inc., Harvey

**Lamp, Incandescent Guards**
McGill Mfg. Co.

**Lamp Locks**
Pass & Seymour, Inc.

**Lamp Replacers**
G. C. A. Mfg. Co.

**Lamps,**
*Arc*
General Electric Co.
National Screw & Tack Co.
Westinghouse Elec. & Mfg. Co.
*Incandescent*
Chicago Electric Lamp Co.
Consolidated Electric Lamp Co.
General Electric Co.
Hygrade Lamp Co.
National Lamp Works
Research Laboratories of G. E.
Western Electric Co.
Westinghouse Lamp Co.
Whitelite Elec. Co.
*Mercury Vapor*
Cooper-Hewitt Elec. Co.
*Miniature, Inc.*
General Electric Co.
Westinghouse Elec. & Mfg. Co.

**Lathes**
Barnes Co., W. F., John

**Leather, Specialties**
Buhrke Co., R. H.

**Lighting Fixtures, Industrial**
Benjamin Elec. Mfg. Co.
Cooper-Hewitt Elec. Co.

**Lightning Arresters**
Delta Star Electric Co.
Electric Power Equip. Corp.
Electric Service Supplies Co.
Electrical Engineers Equip. Co.
General Electric Co.
Hubbard & Co.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

**Line Material**
Archbold-Brady Co.
Clark Electric & Mfg. Co.
Electric Service Supplies Co.
G. & W. Elec. Spec. Co.
General Electric Co.
Hubbard & Co.
Johns-Manville Co.
Ohio Brass Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

**Linemen's Supplies & Tools**
Buhrke Co., R. H.
Industrial Products Co.
Klein & Sons, Mathias
Western Electric Co.

**Lubricators, Hydrostatic Mechanical**
Lunkenheimer Company

**Lugs**
Electric Power Equip. Co.
Sherman Mfg. Co., H. B.

**Machines**
*Armature Notching*
Ferracute Machine Co.
*Balancing*
Olsen Testing Mach. Co., Tinius
*Insulated Wire & Cable Measuring*
Textile Machine Works
*Testing*
Olsen Testing Mach. Co., Tinius
*Wood Boring*
Chic. Pneumatic Tool Co.

**Magnesia Heat Insulation**
Johns-Manville, Inc.
Magnesia Assn. of America

**Magnets**
Acme Wire Co.
Coto-Coil Co.
Dudlo Mfg. Co.
Cutler-Hammer Mfg. Co.
I. R. Nelson Company

**Magnets, Lifting**
Cutler-Hammer Mfg. Co.

**Manganin**
Baker & Co., Inc.

**Magnesia, Heat Insulation**
Johns-Manville, Inc.

**Marble, Switchboard**
Davis Slate & Mfg. Co.

**Marine Lighting and Signaling Apparatus**
Benjamin Elec. Mfg. Co.

**Mechanical Stokers**
Frederick Engineering Co.

**Metals and Alloys**
Rinne,, Albert

**Metal Work**
Patton-MacGuyer Co.

**Meter Testers**
General Electric Co.
States Company
Westinghouse Elec. & Mfg. Co.

**Meters, Flow (See Instruments, Electric and Boiler Room)**

**Mica**
Mica Insulator Co.
Schoonmaker Co., A. O.

**Mining Machinery**
Allis-Chalmers Mfg. Co.
Worthington Pump & Mach. Corp.

**Molded Insulation (See Insulation, Molded)**

**Molded Parts**
Belden Mfg. Co.
Condensite Co. of America

**Monel Castings**
Driver-Harris Co.

**Monel Metal**
International Nickel Co.

**Molding Metal**
National Metal Molding Co.

**Motors**
Advance Electric Co.
Allis-Chalmers Mfg. Co.
American Radio and Research Corp.
Baldor Electric Co.
Bodine Elec. Co.
Burke Elec. Co.
Century Electric Co.
Cleveland Electric Motor Co.
Colonial Fan & Motor Co.
Crawford Mfg. Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Domestic Electric Co.
Electro Dynamic Co.
Emerson Elec. Mfg. Co.
Fairbanks, Morse & Co.
General Electric Co.
Holtzer-Cabot Electric Co.
Howell Elec. Motors Co.
Ideal Elec. & Mfg. Co.
Imperial Electric Co.
Kimble Electric Co.
Marble-Card Elec. Co.
Mechanical Appliance Co.
Peerless Electric Co.
Ridgeway Dynamo & Engine Co.
Robins & Myers Co.
Roth Bros.
Sprague Electric Co.
Star Electric Motor Co.
Sturtevant Co., B. F.
Triumph Electric Co.
Valley Elec. Co.
Wagner Elec. Mfg. Co.
Wesche Electric Co., B. A.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Motor Generator Sets**
Burke Elec. Co.
Valley Electric Co.

**Nickel Alloys**
International Nickel Co.

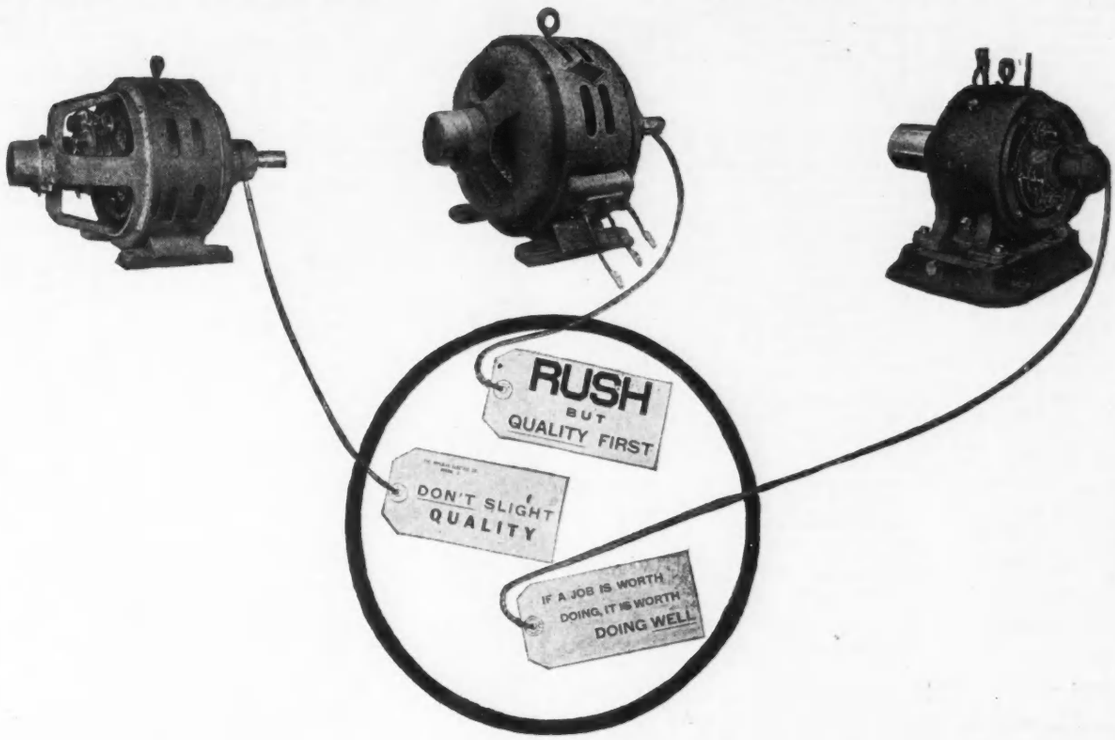
**Nozzles, Spray**
Spray Engrg. Co.

**Oil Coolers**
Griscom-Russell Co.

**Oil Engines (See Engines)**

**Oil and Grease Cups**
Lunkenheimer Company

## Quality—Service—Right Prices—Courteous Treatment




# YOUR ASSURANCE

Quality first always—this is part and parcel of the Imperial Policy.

On a rush job, in order to be assured—and assure our customers—of unerring quality, every motor and every motor part is tagged with quality memos. There is never a time when the men on the job are not constantly reminded that quality comes first and foremost.

And Imperial Service goes with every Imperial Motor. Imperial Engineers, courteous and intelligent, and with a thorough understanding of the needs of your plant, render a helpful, constructive service.

Quality, Service, Right Prices and Courteous Treatment—these are the features back of the name, Imperial.

Your problem is our problem to solve. We offer you our co-operation. Let us hear from you.

**Imperial Electric Company**
**Akron, Ohio**

# IMPERIAL

SINCE 1889

**Oil Heaters**
Griscom-Russell Co.

**Oil Separators and Purifiers**
Delaval Separator Co.

**Oils,**
*Lubricating*
Borne Scrymser Co.
*Transformer*
Borne Scrymser Co.

**Ovens, Industrial**
Young Bros. Co.

**Packing**
Johns-Manville, Inc.

**Paints, Preservative**
Barrett Co., The

**Panel Boards**
Benjamin Elec. Mfg. Co.
General Electric Co.
Krantz Works, (Westinghouse Elec. & Mfg. Co.)
Johns-Manville, Inc.
National Screw & Tack Co.
Trumbull Vanderpool Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.

**Panels, Switchboard**
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

**Pencils, Drafting**
American Lead Pencil Co.

**Penstocks**
American Spiral Pipe Wks.
Armco Iron Culvert & Flume Co.
Kellogg Co., M. W.
Pelton Water Wheel Co.

**Photostats**
Photostat Corporation

**Photometric Apparatus**
Electrical Testing Laboratories
Leeds & Northrup Co.

**Pipe Coils**
Superheater Co.

**Pipe Fittings**
Crane Co.

**Pipe Frame Fittings, Electrical**
Electric Power Equip. Corp.
Schweitzer & Conrad, Inc.

**Pipe (Riveted Steel)**
Riter-Conley Mfg. Co.

**Pipe, Steel Welded**
American Spiral Pipe Wks.

**Plate Work**
Blaw-Knox Co.

**Platinum**
Baker & Co., Inc.

**Plugs, Attachment**
Arrow Elec. Co.
General Electric Co.
Westinghouse Elec. Mfg. Co.

**Plugs**
Arrow Electric Co.
Benjamin Elec. Mfg. Co.
Condit Elec'l Mfg. Co.
Cutler-Hammer Mfg. Co.
Delta Star Electric Co.
General Electric Co.
Hubbell, Inc., Harvey
National Metal Molding Co.
Westinghouse Elec. Mfg. Co.

**Pole Erectors**
American Bridge Co.

**Pole Line Hardware**
Hubbard & Co.
Western Elec. Co.

**Poles**
*Iron and Steel*
Archbold-Brady Co.
Bates Exp. Steel Truss Co.
Blaw-Knox Co.
Carbo Steel Products Co.
Milliken Bros. Mfg. Co.
*Wood*
Hubbard & Co.
Long-Bell Lumber Co.
Northern White Cedar
Pacific Coast Steel Co.
Western Elec. Co.
Western Red Cedar Ass'n

**Poles and Ties**
Naugle Pole & Tie Co.

**Poles, Reinforcing of**
Hubbard & Co.

**Posts, Steel Fence**
Carbo Steel Products Co.

**Potentiometers**
Biddle, James G.
General Electric Co.
Leeds & Northrup Co.
Westinghouse Elec. Mfg. Co.

**Potheads**
Elec'l Development & Machine Co.
Electric Power Equip. Corp.
G. & W. Elec. Spec. Co.
Johns-Manville, Inc.
Okonite Co., The
Northeastern Co., The

**Potts, Electric Melting**
Cutler-Hammer Mfg. Co.

**Presses, Cutting, Foot**
Ferracute Machine Co.

**Projectors, Floodlighting**
Elec. Service Supplies Co.

**Protective Devices**
Benjamin Elec. Mfg. Co.
Condit Elec'l Mfg. Co.
Clark Electric & Mfg. Co.
Electric Power Equip. Corp.
General Electric Co.
Johns-Manville, Inc.
Metropolitan Device Corp.
Schweitzer & Conrad, Inc.
Wadsworth Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.

**Pulleys, Paper**
Rockwood Mfg. Co.

**Pulverized Fuel Equipment**
Combustion Engineering Co.
Fuller-Lehigh Co.
Quigley Furnace Spec. Co.

**Pumps**
*Centrifugal*
Alberger Pump & Condenser Co.
Allis-Chalmers Mfg. Co.
Chicago Pneumatic Tool Co.
DeLaval Steam Turbine Co.
Fairbanks, Morse & Co.
Foster Pump Works, Inc.
Goulds Mfg. Co.
Lea-Courtney Co.
Manistee Iron Works
Midwest Engine Co.
Pelton Water Wheel Co.
Terry Steam Turbine Co.
Worthington Pump & Mach'y Corp.
*Reciprocating*
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
Terry Steam Turbine Co.
Worthington Pump & Mach'y Corp.
*Steam Driven*
Midwest Engine Co.
*Vacuum*
Alberger Pump & Condenser Co.

**Pyrometers**
Bristol Co., The
Leeds & Northrup Co.

**Radio Apparatus**
General Elec. Co.
Westinghouse Elec. & Mfg. Co.

**Rail Bonds**
American Steel & Wire Co.
Condit Elec'l Mfg. Co.
Copper Clad Steel Co.
Ohio Brass Co.

**Ranges**
Westinghouse Elec. & Mfg. Co.

**Receptacles, Signs**
Benjamin Elec. Mfg. Co.

**Rectifiers**
General Electric Co.
Valley Electric Co.
Westinghouse Elec. & Mfg. Co.
*Mercury*
Cooper-Hewitt Elec. Co.

**Reels**
Gleason & Co., J. L.

**Reflectors**
Benjamin Elec. Mfg. Co.
National Screw & Tack Co.
Pittsburgh Reflector & Illuminating Co.

**Refrigerating**
Automatic Refrigerating Co.

**Regulators**
*Feed Water*
Northern Equipment Co.
*Pump*
Northern Equipment Co.
*Pressure*
Engineer Co., The
*Series Lighting*
Packard Elec. Co.

**Repairing**
**(See Searchlight Section)**
Albertson & Co., W. N.
Bonstead Elec. & Mfg. Co.
Brown-Hunkele Corp.
Commonwealth Edison Co.
I. R. Nelson Company

**Resistance Units**
Cutler-Hammer Mfg. Co.
Electric Products Co.
General Electric Co.
High Tension Supply Co.
Industrial Controller Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

**Rheostats**
Biddle, Jas. G.
Campbell Electric Co.
Cutler-Hammer Mfg. Co.
Co.
General Electric Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Electric Co.
Valley Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

**Roofing**
Barrett Co., The

**Rosettes**
Arrow Electric Co.
National Metal Molding Co.
Pass & Seymour, Inc.

**Screens, Intake Water**
Elliott Co.
Link-Belt Company

**Screw Machine Products**
Blake & Johnson Co.

**Searchlights**
General Electric Co.
Westinghouse Elec. Mfg. Co.

**Second-Hand Apparatus**
**(See Searchlight Section)**
Archer & Baldwin, Inc.
Belyea Co.
Brown-Hunkele Corp.
Caddy Elec. Equip. Co.
Chicago Elec. Co.
Coleman & Shoemaker
Commonwealth Edison Co.
Consolidated Wire & Machy. Co.
Davis, J. F.
Davis Machine & Motor Co., Inc.
Duquesne Elec. & Mfg. Co.
Elec. Motor & Repair Co.
Elliott Electric Co.
Gregory Electric Co.
Hall & Co., Stephen
Harris Bros. Co.
Hemphill & Co., J. L.
Independent Elec. Mchy. Co.
Jordan Bros.
Klein & Co., Nathan
MacGovern & Co.
McMillan, A.
Markman Engr. Co.
Miller Owen Elec. Co.
Miller Seldon Elec. Co.
Nashville Industrial Corp.
New Jersey Machy. Exch.
Newark Elec. Repair Co.
Nussbaum Co., V. M.
Power Equip. Co.
Power Machinery Exchange
Ross Power Equip. Co.
Sachsenmaier Co., Geo.
Scheinert & Co., R.
Schwartz & Land
Spilger Elec. Co.
Stewart Elec. Co., John A.
Stewart & Co., Paul
Surety Motor Bonding Co.
Tiffany Electric Co.
Toomey, Inc., Frank
Wickes Mchy. Co.

**Separators**
*Magnetic*
Cutler-Hammer Mfg. Co.
*Steam and Oil*
Cochrane Corp., H. S. B. W.
Elliott Company
Griscom-Russell Co.

**Shade Holders**
Arrow Elec. Co.
Benjamin Elec. Mfg. Co.
Hubbell, Inc., Harvey
National Screw & Tack Co.

**Shades, Tin**
Ostrander & Co., W. R.

**Sheet Metal**
Amer. Sheet & Tin Plate Co.
Bliss Co., E. W.

**Sheets, Electrical**
Amer. Sheet & Tin Plate Co.

**Shelving, Steel**
David Lupton's Sons Co.

**Shipping**
U. S. Shipping Board

**Signals, Industrial**
Benjamin Elec. Mfg. Co.

**Silent Chain Drive**
Morse Chain Co.

**Slate**
Portland Monson Slate Co.
Slatington Bangor Slate Syndicate, Inc.
Structural Slate Co.

**Sleeves, Splicing**
Clark Elec. & Mfg. Co.
Frankel Connector Co.

**Sockets & Receptacles**
Appleton Elec. Co.
Arrow Elec. Co.
Benjamin Elec. Mfg. Co.
Bryant Electric Co.
Cutler-Hammer Co.
General Electric Co.
Hubbell, Inc., Harvey
National Metal Molding Co.
Ostrander & Co., W. R.
Pass & Seymour, Inc.
Westinghouse Elec. Mfg. Co.

**Sockets, Turndown**
Pass & Seymour, Inc.

**Soldering Flux**
Blake Signal & Mfg. Co.
McGill Mfg. Co.

**Soldering Irons**
Cutler-Hammer Mfg. Co.

**Soldering Salts**
Benson Co., Alex

**Solenoids, (see Coils)**

**Specialties**
Connecticut Elec. Mfg. Co.

**Special Machinery**
Blake & Johnson Co.

**Speed Reducers**
Foote Bros. Gear & Machine Co.
Ganschow Co., Wm.

**Spools, Metal Covered**
American Wood Working Co.

**Springs**
American Steel & Wire Co.
Mfg. Co.

**Sprockets, Silent Chain**
Link-Belt Company
Morse Chain Co.
*Stacks*
Heine Safety Boiler Co.

**Stacks, Steel Smoke**
American Bridge Co.

**Stage Lighting Appartus**
Campbell Elec. Co.
Condit Elec'l Mfg. Co.
Ward Leonard Electric Co.

**Staples**
American Steel & Wire Co.
Blake Signal & Mfg. Co.

**Starters, Motor**
Condit Elec'l Mfg. Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Industrial Controller Co.
Sundh Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

**Steam Insulation**
Johns-Manville, Inc.
Magnesia Assn. of America

**Steam Specialties**
Lunkenheimer Company
Power Specialty Co.

**Steel Plate Work**
Heine Safety Boiler Co.

**Steel Structural**
Pacific Coast Steel Co.

**Stokers**
Babcock & Wilcox Co.
Combustion Eng'g Co.
Frederick Engineering Co.
General Elec. Co.
Green Engineering Co.
Laclede Christy
McClave-Brooks Co.
Quigley Furnace Spec. Co.
Riley Stoker Co., Sanford
Westinghouse Elec. & Mfg. Co.

**Stokers, Pulverized Coal**
Combustion Engineering Co.
Fuller-Lehigh Co.

**Storage Battery Casings**
International Nickel Co.

**Stoves, Electric (See Rangers, Etc.)**

**Structural Steel**
Blaw-Knox Co.
Milliken Bros. Mfg. Co.

**Sub-Stations, Outdoor**
Delta Star Electric Co.
Electric Power Equip. Corp.
Elec. Engineers Equip. Co.
Electro Service Co.
General Electric Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

**Superheaters, Steam**
Babcock & Wilcox Co.
Heine Safety Boiler Co.
Power Specialty Co.
Superheater Co.

**Supplies, Railway**
Benjamin Elec. Mfg. Co.
General Electric Co.
Johns-Manville, Inc. . . . .
Ohio Brass Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Supplies**
Benjamin Elec. Mfg. Co.
Electrical Supply Jobbers' Assn.
General Electric Co.
Pass & Seymour, Inc.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Switchboard Mat'l (Ebony Asbestos Wood)**
Johns-Manville, Inc. . . . .

**Switchboard Supplies**
Condit Electric Co.
Electric ower Equip. Corp.
General Electric Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.

**Switchboards**
Allis-Chalmers Mfg. Co.
Condit Elec'l Mfg. Co.
Electric Motor & Engr. Co.
Electrical Engineering Co.
General Electric Co.
Krantz Works (Westinghouse Elec. & Mfg. Co.)
Roller-Smith Co.
Trumbull Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

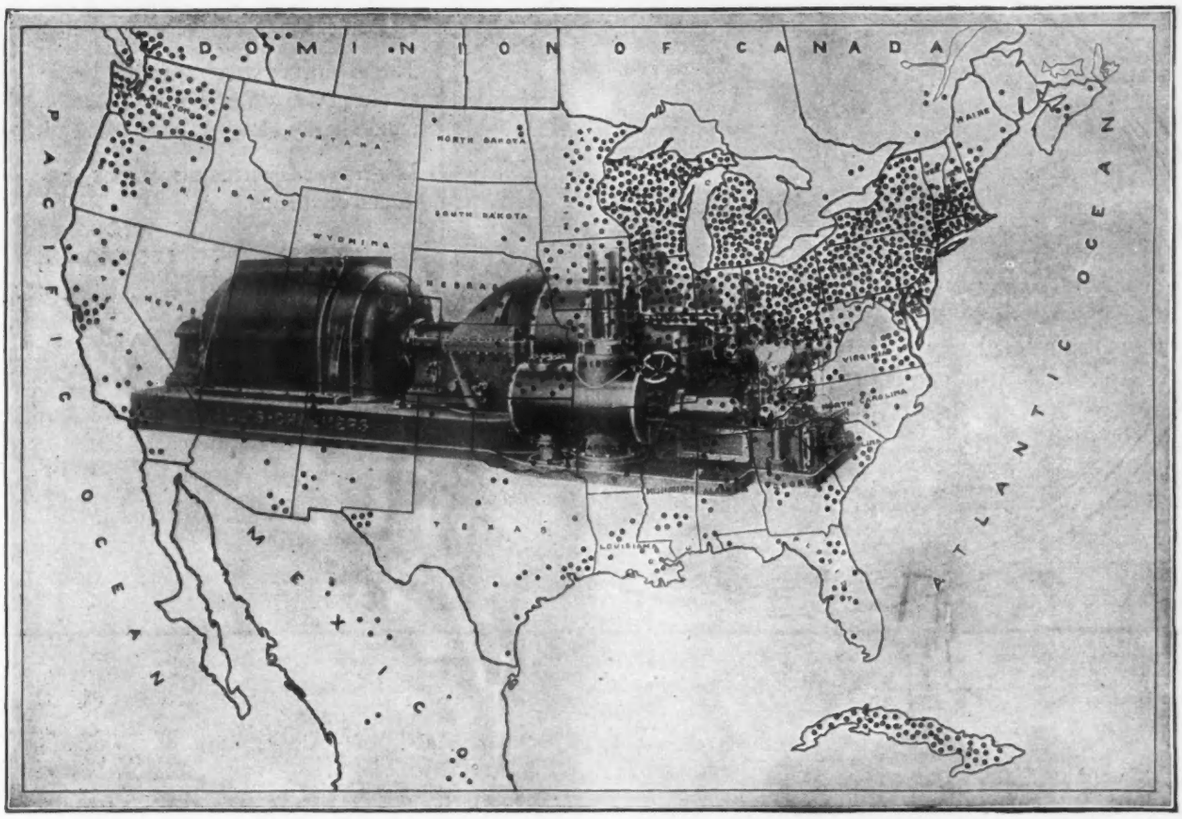
**Switches, Oil**
Rowan Controller Co.

**Switches**
*Air Brake and Pole Top*
Delta-Star Elec. Co.
Electrical Engineers Equipment Co.
Electric ower Equip. Corp.
General Electric Co.
Hi-Voltage Equipment Co.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. Mfg. Co.
*Battery*
Trumbull-Vanderpoel Elec.
*Disconnecting*
Anderson Mfg. Co., A. & J. M.
Delta Star Electric Co.
Electric Power Equip. Corp.
Elec'l Development & Machine Co.
Elec'l Engineers Equip. Co.
General Electric Co.
Pacific Electric Mfg. Co.
Schweitzer & Conrad, Inc.
Trumbull Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
*Float*
Cutler-Hammer Mfg. Co.
General Elec. Co.
Sundh Elec. Co.
Westinghouse Elec. & Mfg. Co.
*Fuse*
General Electric Co.
Hi-Voltage Equipment Co
Metropolitan Device Corp.
Reinforced Switch & Mfg. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. Mfg. Co.
*Knife*
Anderson Mfg. Co., A. & J. M.
Condit Elec'l Mfg. Co.
Cutter Co., The
General Electric Co.
Krantz Works (Westinghouse Elec. & Mfg. Co.)
Reinforced Switch & Mfg. Co.
Trumbull Elec. Mfg. Co.
Trumbull Vanderpoel Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.
*Oil*
Condit Elec'l Mfg. Co.
General Electric Co.
Rowan Controller Co.
Westinghouse Elec. & Mfg. Co.
*Pole Top*
Condit Elec'l Mfg. Co.
*Pull*
Arrow Electric Co.
*Remote Control*
Anderson Mfg. Co., A. & J. M.
Cutler-Hammer Mfg. Co.
General Electric Co.
Industrial Controller Co.
Payne Deane, Ltd.
Railway & Industrial Eng. Co.
Sundh Elec. Co.
Westinghouse Elec. & Mfg. Co.
*Safety Enclosed*
General Electric Co.
Johns-Manville, Inc.
Trumbull Elec. Mfg. Co.
Trumbull Vanderpoel Electric Mfg. Co.
Wadsworth Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
*Series*
G. & W. Elec. Spec. Co.
General Electric Co.
Westinghouse Elec. Mfg. Co.
*Snap and Push Button*
Arrow Electric Co.
Bryant Electric Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Pass & Seymour, Inc.
Western Electric Co.
Westinghouse Elec. Mfg. Co.
*Time*
Anderson Mfg. Co., A. & J. M.
Campbell Elec. Co.
General Electric Co.
Hartford Time Switch Co.
Paragon Electric Co.
Westinghouse Elec. & Mfg. Co.

**Synchroscopes**
Bristol Co., The
General Elec. Co.
Roller Smith Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Inst. Co.

**Tachometers**
Biddle, James G.
Bristol Co., The
Foxboro Co.
Johns-Manville, Inc.
Roller-Smith Co.
Zernickow, O.

# Allis-Chalmers Steam Turbine and Alternator Units




## Each Dot Represents an Allis-Chalmers Steam Turbine Installation and a Satisfied Customer

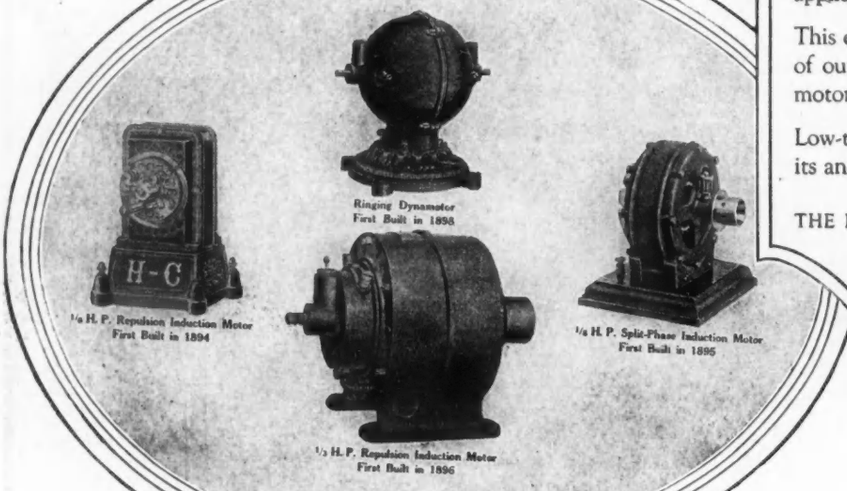
Satisfied customers are possible only through
EFFICIENT AND UNINTERRUPTED SERVICE

**Allis-Chalmers Steam Turbines are highly efficient, rugged in construction, built for continuous service.**

# ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.

# Holtzer-Cabot Motors


H-C
Ringing Dynamotor
First Built in 1898
1/6 H. P. Repulsion Induction Motor
First Built in 1894
1/3 H. P. Repulsion Induction Motor
First Built in 1896
1/4 H. P. Split-Phase Induction Motor
First Built in 1895

## EXPERIENCE

SOME of our types of twenty-five years ago. On motors such as these Holtzer-Cabot reputation was built.

During the long intervening years we have taken part in the development of many varied and difficult motor applications.

This experience we place at the service of our patrons in expert advice and in motors having a low percentage of failure.

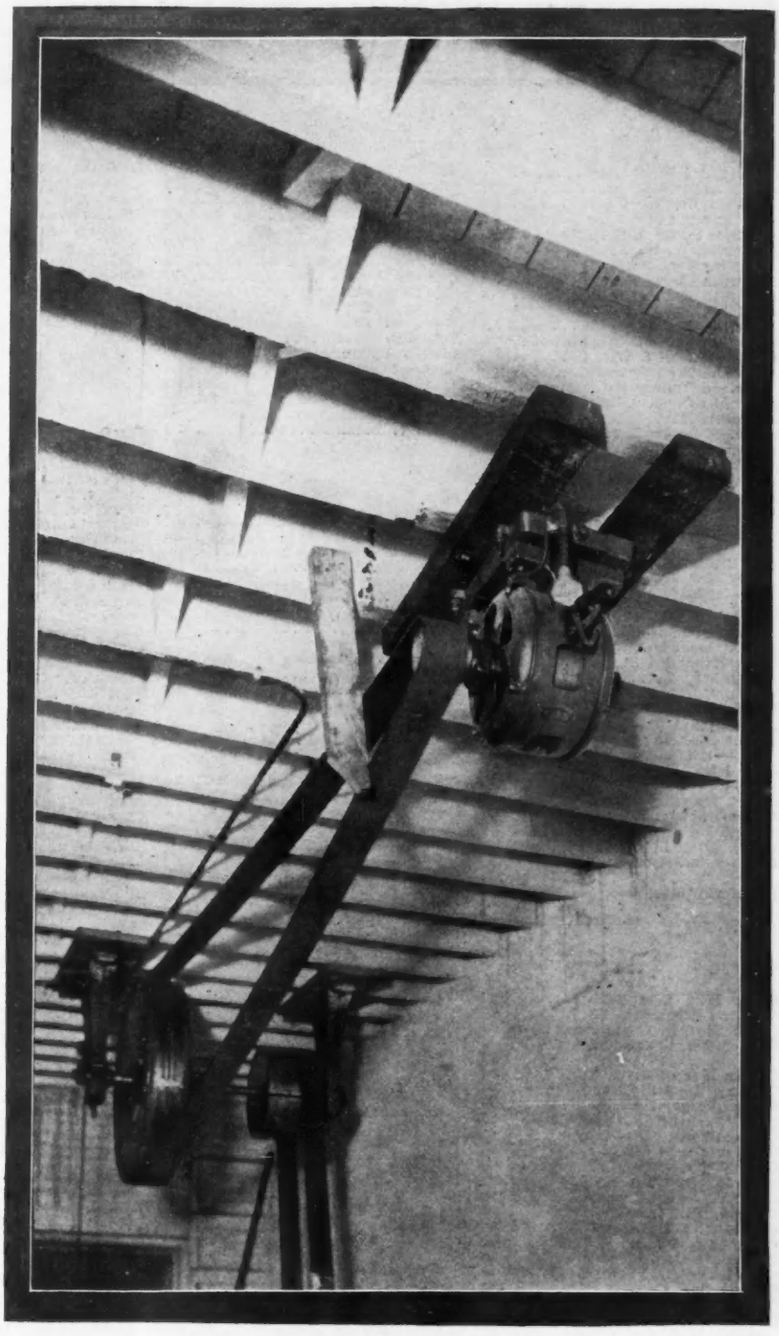
Low-trouble-factor motors conserve profits and reputation.

THE HOLTZER-CABOT ELECTRIC CO.
BOSTON, MASS.

CHICAGO DETROIT NEW YORK PHILADELPHIA MINNEAPOLIS BALTIMORE ST. LOUIS


**Tanks**
Heine Safety Boiler Co.
Riter-Conley Mfg. Co.
**Tape and Webbing**
Anchor Webbing Co.
**Taps and Dies**
Carpenter Tap & Die Co., J. M.
**Tar, Coal**
Barrett Co., The
**Telephones**
Holtzer-Cabot Electric Co.
Western Elec. Co.
**Testing Apparatus**
American Transformer Co.
Biddle, James G.
General Electric Co.
Leeds & Northrup Co.
Rawson Electrical Instru. Co.
Roller-Smith Co.
States Co.
Thompson-Levering Co.
Westinghouse Elec. & Mfg. Co.
Zernickow, O.
**Testing Laboratories**
Electrical Testing Laboratories
**Theatre Dimmers**
Cutler-Hamer Mfg. Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Electric Co.
Westinghouse Elec. Mfg. Co.
**Thermometers**
Bristol Co., The
Foxboro Co.
Taylor Instrument Co.
**Tie Bands**
Copper Clad Steel Co.
**Toaster**
Electro Weld Co., The
Westinghouse Elec. & Mfg. Co.
**Tools**
*Construction*
Klein & Sons, Mathias
Oshkosh Mfg. Co.
*Pneumatic*
Chicago Pneumatic Co.
*Portable Elec.*
Chicago Pneumatic Co.
*Underground Conduit*
Cope, T. J.
Railway & Industrial Eng. Co.
**Towers**
*Radio*
American Bridge Co.
Blaw-Knox Co.
Milliken Bros. Mfg. Co., Inc.
Pacific Coast Steel Co.
*Transmission*
American Bridge Co.
Archbold-Brady Co.
Bates Exp. Steel Truss Co.
Coombs & Co., R. D.
Milliken Bros. Mfg. Co. Inc.
Pacific Coast Steel Co.
Railway & Industrial Eng. Co.
Riter-Conley Mfg. Co.
**Transformers**
Acme Apparatus Co.
Allis-Chalmers Mfg. Co.
American Transformer Co.
Campbell Elec. Co.
Enterprise Elec. Co.
General Electric Co.
I. R. Nelson Company
Kuhlman Electric Co.
Moloney Electric Co.
Packard Elec. Co.
Pittsburgh Transformer Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
**Transformers, Bell Ringing**
General Elec. Co.
Kllark Elec. Mfg. Co.
Metropolitan Device Corp.
Packard Elec. Co.
Westinghouse Elec. & Mfg. Co.
**Transmission, Silent Chain**
Blaw-Knox Co.
Link-Belt Company
Morse Chain Co.
**Traps, Steam**
Elliott Company
Nicholson & Co., W. H.
**Trucks**
Bowser & Co., Inc., S. F.
Cowan Truck Co.
**Tube Cleaners**
Yarnall-Waring Co.
**Turbines, Hydraulic**
Allis-Chalmers Mfg. Co.
I. P. Morris Dept.
Leffel & Co., James
Pelton Water Wheel Co.
Smith Co., S. Morgan
Trump Mfg. Co.
**Turbines, Steam**
Alberger Pump & Condensor Co.
Allis-Chalmers Mfg. Co.
DeLaval Steam Turbine Co.
General Electric Co.
Kerr Turbine Co.
Midwest Ergine Co.
Morris Dept. I. P.
Ridgway Dynamo & Engine Co.
Sturtevant Co., B. F.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.
**Turbo-Generators**
Allis-Chalmers Mfg. Co.
General Electric Co.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.
**Underground Conduit and Bends**
Fibre Conduit Co.
Johns-Manville Co.
National Fireproofing Co.
**Vacuum Cleaners**
Hugro Mfg. Co.
Western Elec. Co.
**Valves**
*Balanced Throttle*
Lunkenheimer Company
*Blow-Off*
Lunkenheimer Company
*Check*
Cochrane Corp., H. S.B. W.
*Cross*
Lunkenheimer Company
*Elbow*
Golden-Anderson Valve Spec. Co.
*Flow*
Cochrane Corp., H. S.B. W.
*Gate*
Lunkenheimer Company
*Globe, Angle and Check*
Golden-Anderson Valve Spec. Co.
Lunkenheimer Company
*Hydraulic*
Larner-Johnson Co.
Ohio Brass Co.
Rensselaer Valve Co.
*Pop Safety and Relief*
Lunkenheimer Company
*Regrinding*
Lunkenheimer Company
*Non-Return, Safety Boiler Stop*
Lunkenheimer Company
*Steam*
Crane Co.
Elliott Co.
International Nickel Co.
Larner-Johnson Co.
Yarnall-Waring Co.
*Steel*
Lunkenheimer Company
*Superheated Steam*
Lunkenheimer Company
*Regulating*
Northern Equipment Co.
**Vibrators**
Shelton Elec. Co.
**Washers**
Mass. Machine Shop, Inc.
**Washing Machines**
Nineteen Hundred Washer Co.
Western Elec. Co.
**Water Heaters**
Aetna Electric App. Co.
Cochrane Corp., H. S.B. W.
Cutler-Hammer Mfg. Co.
**Waterproofing Materials**
Barrett Co., The
Johns-Manville, Inc.
Mitchell-Rand Mfg. Co.
**Water Purifying Apparatus**
Yarnall-Waring Co.
**Water Softening Apparatus**
Yarnall-Waring Co.
**Water Wheels, Impulse Turbines**
Allis-Chalmers Mfg. Co.
Pelton Water Wheel Co.
**Water Wheel Governors**
Pelton Water Wheel Co.
Woodward Governor Co.
**Wattmeters, Watt-Hour Meters (See Instruments)**
**Welder**
*Portable*
Ohio Brass Co.
*Rail Joint*
Ohio Brass Co.
**Welders, Arc**
General Electric Co.
Westinghouse Elec. & Mfg. Co.
**Welding Machines**
Allan Mfg. & Welding Corp.
General Electric Co.
Ohio Brass Co.
Westinghouse Elec. & Mfg. Co.
**Winding Machinery**
Coto-Coil Co.
New England Butt Co.
**Wire and Cables**
*Asbestos Covered*
D. & W. Fuse Co.
*Automotive*
Packard Elec. Co.
*Bare Copper*
American Copper Products Co.
American Brass Co.
Amer. Steel & Wire Co.
Anaconda Copper Mining Co.
*Copper Clad*
American Copper Products Co.
Copper Clad Steel Co.
Standard Underground Cable Co.
*Enamel*
Dudlo Mfg. Co.
Maring Wire Co.
*Magnet*
Acme Wire Co.
American Steel & Wire Co.
Belden Mfg. Co.
D. & W. Fuse Co.
Dudlo Mfg. Co.
Hazard Mfg. Co.
Maring Wire Co.
Roebling's Sons Co., J. A.
Rome Wire Co.
Western Electric Co.
*Resistance*
Driver Harris Co.
General Electric Co.
Habirshaw Elec. Cable Co.
International Nickel Co.
Rinne, Albert
Westinghouse Elec. & Mfg.
*Rubber Covered and Weatherproof*
Acme Wire Co.
American Copper Products Co.
Atlantic Ins. Wire & Cable Co.
Collyer Ins. Wire & Cable Co.
Goodrich Rubber Co., B. F.
Habirshaw Elec. Cable Co.
Hazard Mfg. Co.
Hofmann, Alfred
Indiana Rub. & Ins. Wire Co.
Lowell Insulated Wrie Co.
Okonite Co., The
Packard Elec. Co.
A.
Roebling's Sons Co., John
Rome Wire Co.
Safety Ins. Wire & Cable Co.
Simplex Wire & Cable Co
Western Electric Co.
*Steel*
American Steel & Wire Co
*Trolley*
Anaconda Copper Mining Co
**Wiring Devices**
Arrow Elec. Co.
Benjamin Elec. Mfg. Co.
**Wireless Apparatus**
General Electric Co.
Westinghouse Elec. & Mfg. Co.
**Wood Preservatives**
Barrett Co., The
Northeastern Co.
Anderson Mfg. Co., A. & J. M.
**X-Ray Apparatus**
Campbell Elec. Co.

# Meeting the Needs of Intensive Production



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# Crawford

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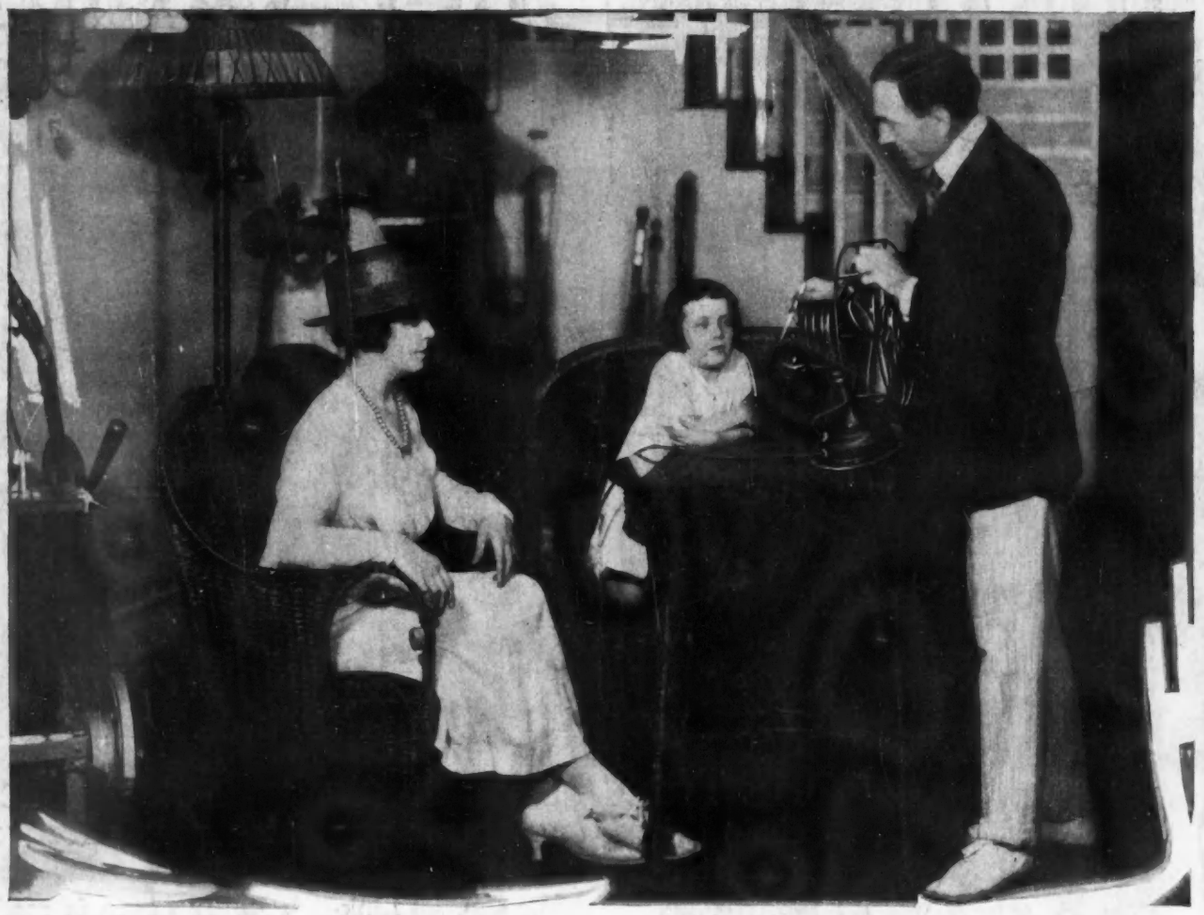

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